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ABSTRACT

These 33 learning guides are self-instructional packets for 33 tasks identified as essential for performance on an entry-level job in automotive mechanics. Each guide is based on a terminal performance objective (task) and 1-9 enabling objectives. For each enabling objective, some or all of these materials may be presented: learning steps (outline of student activities) with necessary resources/materials cited, instruction sheet(s), and self-check with answer key. A performance test and/or a written test (with answer key) concludes each guide. Tasks covered in these guides include balancing tires; diagnosing and repairing front end, power brake assembly, drive lines, ignition system problems; identifying steering, fuel, starting, and charging system components; reconditioning brake system; performing minor tune-up; rebuilding carburetor; identifying hand tools, safety procedures in the shop, metric units, fasteners, grades, bolts, engine components, ignition components; replacing tires; flaring and splicing tubing; servicing automatic transmission; performing chassis maintenance and inspection; repairing exhaust system; testing cooling system; identifying, servicing, and testing a battery; connecting scope, interpreting patterns, describing scope hook-up, identifying patterns; repairing charging system components; testing charging system with a volt amp tester; and disassembling and reassembling ignition components. (YLB)

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Automotive Mechanics
STUDENT LEARNING GUIDES

- ED210427
- F-04 Identify Alignment Angles and Describe How They Affect Vehicle Operation
 - F-03 Balance Tires
 - F-02 Diagnose and Repair Front End
 - F-01 Identify Steering System components
 - E-03 Diagnose and Repair Power Brake Assembly
 - E-02 Recondition Brake System
 - D-07 Perform Minor Tune-Up
 - D-04 Rebuild Common Carburetor
 - D-01 Identify Fuel System Components
 - A-02 Identify Hand Tools and Describe Their Use
 - A-03 Identify Safety Procedures in the Shop
 - B-03 Diagnose and Repair Drive Lines
 - B-02 Replace Tires
 - B-01 Flare and Splice Tubing
 - A-06 Identify and Use Metric Units
 - A-05 Identify and Read Scales of Various Measuring Instruments
 - A-04 Identify fasteners, Grades and Bolts
 - B-04 Service Automatic Transmission
 - B-05 Perform Chassis Maintenance and Inspection
 - B-06 Repair Exhaust System
 - B-07 Identify Engine Components
 - B-08 Test Cooling System
 - C-01 Identify and Describe Basic Electrical Components
 - C-02 Identify, Service and Test a Battery
 - C-11 Connect Scope and Interpret Patterns
 - C-10 Describe Scope Hook-up and Identify Patterns
 - C-09 Identify Starting System Components and Describe Operation
 - C-08 Repair Charging System Components
 - C-07 Test Charging System With a Volt Amp Tester
 - C-06 Identify Charging System Components
 - C-05 Diagnose and Repair Ignition System Problems
 - C-04 Disassemble and Reassemble Ignition Components
 - C-03 Identify Ignition Components and Describe Operation

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IN-9043-F-04

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Identify Alignment Angles and Describe How They Affect Vehicle Operation

DUTY:

Repairing and Maintaining Front End

PURPOSE :

Ideally it would be possible to align a car without knowing anything about alignment angles. However, being able to operate alignment equipment is only a small part of a good alignment. In order to align a car properly, you must recognize certain symptoms and what each symptom points to and how to correct it. To be able to do this you must know and understand the theory behind why a vehicle needs proper aligning.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	F	04	

REVISED :				

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:****GIVEN:** a list of alignment angles,**YOU WILL:** define each angle and describe how each affects vehicle operation.**HOW WELL:** You must successfully complete the Written Test.**NOTE:**

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Identify alignment angles.
2. Describe how alignment angles affect vehicle operation.

DEPT.	PROG.	DUTY	TASK
IN	9043	F	04

ENABLING OBJECTIVE NO. 1

RVTC

Identify alignment angles.

LEARNING STEPS

1. Read Resource No. 1 to identify alignment angles.
2. Evaluate your knowledge by completing the Self-Check.
3. Go on to Enabling Objective No. 2.

RESOURCES

1. a. Text: Automotive Mechanics, pages 523 - 527.
b. Text: Auto Mechanics Fundamentals, pages 307 - 311.
2. Text: Automotive Mechanics, Review Questions, page 538.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	04	1

ENABLING OBJECTIVE NO. 2

RVTC

Describe how alignment angles affect vehicle operation.

LEARNING STEPS

1. Review Resource No. 1 describing how alignment angles affect vehicle operation.
2. When you think you can attain this task, take the Written Test.

RESOURCES

1. a. Text: Automotive Mechanics, pages 523 - 527.
b. Text: Auto Mechanics Fundamentals, pages 307 - 311.
2. Written Test for task F-04.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	04	2

WRITTEN TEST FOR TASK NO. F-04

RVTC

TASK:

Identify Alignment Angles and Describe How They Affect Vehicle Operation

IN-9043-F-04

DirectionsPAGE 1 OF 1

The purpose of this test is to determine if you fully understand how to identify alignment angles and describe how they affect vehicle operation. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Matching. On the separate Answer Sheet, write the letter of the item that best identifies each definition.

DO NOT MARK ON THIS TEST!

Matching questions

- | | |
|--|------------------------------|
| 1. Tilting of wheels from vertical in relation to straight up and down | a. toe-in |
| 2. Various angles between front wheels | b. steering linkage |
| 3. The amount the ball joints are tilted inward from vertical | c. front end geometry |
| 4. The camber angle plus the steering axis angle | d. tie-rod end |
| 5. Tilting forward or backward from vertical | e. camber |
| 6. The distance between the front of the wheels as compared to the distance between the rear of the wheels | f. wheel bearing adjustment |
| 7. Connects steering knuckle with pitman arm | g. steering axis inclination |
| 8. The distance between front of wheels in relation to frame during turns | h. toe-out on turns |
| 9. The amount of free play between spindle and drum | i. caster |
| 10. Connects steering arm to tie-rod | j. inclined angle |
| | k. steering box |
| | l. idler arm |
| | m. front end wear |
| | n. king pin |

DEPT.	PROG.	DUTY	TASK
IN	9043	F	04

WRITTEN TEST FOR TASK NO. F-04

RVTC

TASK:

Identify Alignment Angles and Describe How They Affect Vehicle Operation

ANSWER KEY

PAGE 1 OF 1

Multiple Choice questions

- | | | | | |
|--------|---------|---------|---------|---------|
| ___ 1. | ___ 6. | ___ 11. | ___ 16. | ___ 21. |
| ___ 2. | ___ 7. | ___ 12. | ___ 17. | ___ 22. |
| ___ 3. | ___ 8. | ___ 13. | ___ 18. | ___ 23. |
| ___ 4. | ___ 9. | ___ 14. | ___ 19. | ___ 24. |
| ___ 5. | ___ 10. | ___ 15. | ___ 20. | ___ 25. |

True-False questions

- | | | | | |
|--------|---------|---------|---------|---------|
| T F 1. | T F 6. | T F 11. | T F 16. | T F 21. |
| T F 2. | T F 7. | T F 12. | T F 17. | T F 22. |
| T F 3. | T F 8. | T F 13. | T F 18. | T F 23. |
| T F 4. | T F 9. | T F 14. | T F 19. | T F 24. |
| T F 5. | T F 10. | T F 15. | T F 20. | T F 25. |

Matching questions

- | | | | | |
|-------------|--------------|---------|---------|---------|
| <u>e</u> 1. | <u>a</u> 6. | ___ 11. | ___ 16. | ___ 21. |
| <u>c</u> 2. | <u>b</u> 7. | ___ 12. | ___ 17. | ___ 22. |
| <u>j</u> 3. | <u>h</u> 8. | ___ 13. | ___ 18. | ___ 23. |
| <u>g</u> 4. | <u>f</u> 9. | ___ 14. | ___ 19. | ___ 24. |
| <u>i</u> 5. | <u>d</u> 10. | ___ 15. | ___ 20. | ___ 25. |

DEPT.	PROG.	DUTY	TASK
IN	9043	F	04

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IN-9043-F-03

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Balance Tires

DUTY:

Repairing and Maintaining Front End

PURPOSE :

Tire life can be reduced as much as 50% if tires are not balanced. This is a task common to most auto repair shops. The spin balancer is used for this task but caution must be used.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	F	03	

REVISED :

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:****GIVEN:** a shop vehicle,**YOU WILL:** balance tires using a spin balancer.**HOW WELL:** Your performance will be assessed by your instructor using the Performance Test on page 12.**NOTE:**

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Identify reasons for balancing tires.
2. Prepare vehicle for balancing.
3. Balance tires.

DEPT.	PROG.	DUTY	TASK
IN	9043	F	03

ENABLING OBJECTIVE NO. 1
RVTC

Identify reasons for balancing tires.

LEARNING STEPS

1. Read Resource No. 1 to identify reasons for balancing tires.
2. View Resource No. 2 to identify the process for balancing tires.
3. Read Resource No. 3 to identify the results of static and dynamic unbalance conditions.
4. Evaluate your knowledge by completing the Self-Check.
5. Go on to Enabling Objective No 2.

RESOURCES

1. Text: Crouse Automotive Mechanics, pages 574 - 580.
2. Bergwall filmstrip/tape: No. 417.
3. Text: Automotive Encyclopedia, pages 497 - 499.
4. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	03	1

SELF-CHECK

BVTC

Directions

Evaluate your knowledge by answering True or False to the items below on a separate of paper.

1. The life expectancy of an unbalanced tire can be reduced by as much as 50%.
2. Balance does not affect tire wear if the vehicle is driven 55 mph or slower.
3. Driving habits can cause tires to become unbalanced.
4. Static balance is the equal distribution of weight around the wheel and tire.
5. Dynamic balance is the equal distribution of weight on each side of the vertical center line of the wheel and tire assembly.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. CBU.
IN	9043	F	03	1

SELF-CHECK

RVTC

Answer Key

1. T
2. F
3. T
4. T
5. T

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	F	03	1

ENABLING OBJECTIVE NO. 2

RVTC

Prepare vehicle for balancing.

LEARNING STEPS

1. Read Resource No. 1 to identify steps in preparing vehicle.
2. Evaluate your knowledge by completing the Self-Check.
3. See your instructor before going on to Enabling Objective No. 3.

RESOURCES

1. Instruction Sheet enclosed, Vehicle Preparation
2. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	03	2

INSTRUCTION SHEET

RVTC

Vehicle Preparation

PAGE 1 OF 1

Tools and Equipment

- 1 2 ton floor jack
- 2 jack stands
- 2 wheel chocks
- 1 pair safety glasses
- wheel spinner machine
- wheel weight pliers
- Hunter wheel balancer with wheel adaptors
- 1 piece of chalk

1. Drive vehicle into the service area (area 1 or 2) where 220 volt outlet is provided.
2. Place the vehicle in park position (if automatic transmission) and set the hand brake.
3. Chock the rear wheels.
4. Lift the front wheels approximately three inches off the floor and place a jack stand under the frame to support the vehicle.

NOTE: Do not place the jack stand under the suspension. This would prevent the wheel from vibrating and make the balance more difficult.

5. Place the wheel spinner in front of one front tire, approximately three inches from the tire.
6. Plug in the spinner to the 220 outlet.
7. Select the adaptor to fit the wheel diameter of the vehicle, 13, 14, or 15 inch.
8. Attach the adaptor to the wheel.

NOTE: The wheel cover (hub cap) may have to be removed.

9. Attach the Hunter balancer to the adaptor.

NOTE: Do not force the aligning peg lock, they should lock easily when the balancer is in the proper position.

10. Rotate the wheel by hand, inspecting the adaptor and balancer to be sure it is secure. Pull on the balancer firmly in several spots to be sure it is fastened in all three locks and the adaptor is secured firmly to the wheel.

CAUTION: Do not spin the wheel until your instructor has inspected these steps. The balancer can cause serious injury if it should become loose while spinning.

11. You are now ready to balance the wheel.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	03	2

SELF-CHECK

RVTC

Directions

Evaluate your work by answering the items below.

All items should receive a "YES" response.

- | | <u>YES</u> | <u>NO</u> |
|---|------------|-----------|
| 1. Were all tools obtained?..... | ___ | ___ |
| 2. Was vehicle in park (if automatic) with wheels
chocked?..... | ___ | ___ |
| 3. Were front wheels high enough so they did not scrub
the floor while spinning?..... | ___ | ___ |
| 4. Were front wheels in position for the spinner to reach
the tire?..... | ___ | ___ |
| 5. Was jack stand under the frame?..... | ___ | ___ |
| 6. Were red lock's turned in to the wheel on the adaptor? | ___ | ___ |
| 7. Were all three locking lugs in position on the
balancer?..... | ___ | ___ |
| 8. Were balancer and adaptor firmly secured against the
wheel in a position which will not vibrate?..... | ___ | ___ |
| 9. Were safety glasses worn?..... | ___ | ___ |

If you received a "NO" response for any item, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	F	03	2

ENABLING OBJECTIVE NO. 3

RVTC

Balance tires.

LEARNING STEPS

1. View Resource No. 1 to identify the steps in balancing
2. Attend Resource No. 2 to identify the procedure for using the spin balancer.
3. Using Resource No. 3, practice balancing the tires.
4. When you think you can perform this task, take the Performance Test.

RESOURCES

1. Bergwall filmstrip/tape: No. 417.
2. Demonstration
3. a. Instruction Sheet enclosed, Balancing Tires With The Spin Balancer.
b. Self-Check enclosed.
4. Performance Test for task F-03.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	03	3

INSTRUCTION SHEET

10
RVTC

PAGE 1 OF 1

Balancing Tires With The Spin Balancer

NOTE: The vehicle should be set up for balancing as outlined in Enabling Objective No. 2.

1. Remove all weight from wheel, both inside and out.
2. Set the scale on the balancer to indicate approximately one ounce of weight. This is controlled by the inside roller.
3. Engage the spinner and spin the wheel to approximately 55 mph.

CAUTION: Do not over spin the wheel. This can result in injury. This spinner will spin a wheel much faster than is necessary to balance the wheel.

4. Release the spinner handle and observe the vibration from the wheel. Hold the outside rollers to move the weight around the wheel. When the vibration is at a minimum, release the rollers.

NOTE: It may be necessary to engage the spinner several times to maintain approximately 55 mph while balancing.

5. You now have found the location of the point where weight is needed, to find how much weight is needed hold the inside rollers this will add or remove weight with the wheel spinning, when the vibration is at a minimum, move back to the outside rollers and re-check the location, this will fine tune the balance.

NOTE: If the vehicle is equipped with disc brakes it may be necessary to retract the pads to prevent drag while spinning. Excess drag can damage the spinner motor.

6. Stop the wheel from spinning with the spinner brake handle after step 5 has been completed. The weight scale will indicate the amount and location of the weight to be used. Do not use all the weight indicated with this first spin, use approximately 3/4 of the amount and place $\frac{1}{2}$ on the outside of the wheel. Mark the location of the outside weight with chalk on the surface of the tire tread. Now place the remaining $\frac{1}{2}$ on the inside of the wheel.
7. Repeat Steps 3, 4, 5 and 6 to get a more accurate balance. This time use all the weight indicated. Observe the vibration from the wheel, at this point it should be at a minimum.
8. Move the spinning equipment to the opposite front wheel and repeat the spinning operation. The rear wheels should be mounted on the front to be spin balanced. Spinning rear wheels (one at a time) can damage some types of differentials.
9. When you have balanced all the tires indicated on the repair order return all tools and equipment to the storage area.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	F	03	3

SELF-CHECK

11

RVTC

Directions

Evaluate your work by answering the items below.

All items should receive a "YES" response.

- | | <u>YES</u> | <u>NO</u> |
|--|------------|-----------|
| 1. Were safety glasses worn?..... | _____ | _____ |
| 2. Was vehicle prepared for balancing using procedure in Enabling Objective No. 1?..... | _____ | _____ |
| 3. Were adaptor and balancer attached firmly to wheel?.. | _____ | _____ |
| 4. Was approximately 1 ounce of weight added to the balancer before the first spin?..... | _____ | _____ |
| 5. Was all weight removed from wheel before the first spin?..... | _____ | _____ |
| 6. Was position located where weight was needed with inside rollers before rotating the outside rollers?.... | _____ | _____ |
| 7. Was vibration reduced to a minimum?..... | _____ | _____ |
| 8. Was weight indicated reduced and divided on the first spin?..... | _____ | _____ |
| 9. Was the wheel not spun at an excessive speed, over 55 mph?..... | _____ | _____ |
| 10. Was second spin completed and all indicated weight used?..... | _____ | _____ |
| 11. Was the wheel and tire spun with little or no vibration?..... | _____ | _____ |

If you received a "NO" response for any item, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	F	03	3

PERFORMANCE TEST FOR TASK NO. F-03

RVTC

IN-9043-F-03

TASK:

Balance Tires

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will balance tires. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Were safety glasses worn?		
2.	Was vehicle prepared for balancing using procedure in Enabling Objective No. 1?		
3.	Were adaptor and balancer attached firmly to wheel?		
4.	Was approximately 1 ounce of weight added to the balancer before the first spin?		
5.	Was all weight removed from wheel before the first spin?		
6.	Was position located where weight was needed with inside rollers before rotating the outside rollers? ...		
7.	Was vibration reduced to a minimum?		
8.	Was weight indicated reduced and divided on the first spin?		
9.	Was the wheel not spun at an excessive speed, over 55 mph?		
10.	Was second spin completed and all indicated weight used?		
11.	Were the wheel and the tire spun with little or no vibration?		

☐ ATTAINED
☐ NOT ATTAINED

Score _____ EVALUATOR'S SIGNATURE _____

DEPT.	PROG.	DUTY	TASK	ATTEMPT
IN	9043	F	03	

Page 1 of 1

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IN-9043-F-02

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Diagnose and Repair Front End

DUTY:

Repairing and Maintaining Front End

PURPOSE :

Many parts of the front end are critical to the operation of the automobile. You must be able to diagnose and repair worn or damaged parts as well as correct any problems which are caused from misaligned parts.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	F	02	F-01

REVISED :

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

GIVEN: a test vehicle,

YOU WILL: diagnose and repair front end.

HOW WELL: You must successfully complete the Written Test.
Your performance will be assessed by your instructor
using the Performance Test on page 24.

NOTE:

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL
INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE,
SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Determine procedure to inspect the front end steering, suspension and wheel parts.
2. Service and adjust front wheel bearings.
3. Remove and install spindle assembly and ball joints.
4. Remove and install front shock absorbers.
5. Measure and adjust torsion bar height.
6. Replace front coil springs and torsion bars.
7. Replace front suspension control arms and bushings.
8. Replace steering linkage components and dampers.
9. Diagnose and repair a worn front end.

DEPT.	PROG.	DUTY	TASK
IN	9043	F	02

ENABLING OBJECTIVE NO. 1
RVTC

Determine procedure to inspect the front end steering, suspension and wheel parts.

LEARNING STEPS

1. View Resource No. 1 to identify the procedure for recognizing front end problems.
2. View Resource No. 2 to identify the procedure to inspect front end components using inspection reports.
3. Read and complete Resource No. 3 to identify the procedure for inspecting tires, wheels and front and rear suspension parts.
4. Read and complete Resource No. 4 to inspect steering linkage.
5. Evaluate your knowledge by completing the Self-Check.
6. Go on to Enabling Objective No. 2.

RESOURCES

1. Bergwall filmstrip/tape: No. 403, part 2.
2. Hoffman slide/tape unit: 2.7.A.
3. Text: Steering, Suspension and Wheel Service, Unit 1, pages 33-110.
4. Text: Steering, Suspension and Wheel Service, Unit 1, pages 111 - 131.
5. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	02	1

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer(s) on a separate sheet of paper.

1. Which safety precautions are important to remember when using a wheel alignment rack?
 - a. have another person help guide you on the rack
 - b. drive the vehicle on the rack quickly
 - c. chock the rear wheels to prevent the vehicle from rolling
 - d. do not drive a vehicle with a cold engine on fast idle
2. When you inspect the front wheels and tires, where should the hydraulic jack be positioned?
 - a. under the upper control arm
 - b. under the frame of the cowl area
 - c. under the center of the front cross-member
 - d. under the transmission
3. Florida vehicle inspection states that tires will be rejected if the tread is worn to less than:
 - a. 1/32 inch remaining.
 - b. 2/32 inch remaining.
 - c. 3/32 inch remaining.
 - d. 5/32 inch remaining.
4. In order to measure radial or lateral run-out you should use a:
 - a. screwdriver.
 - b. steel tape.
 - c. dial indicator.
 - d. micrometer.
5. Vehicle riding height affects all the following except:
 - a. riding stability.
 - b. wheel alignment.
 - c. headlight aiming.
 - d. noise level.
6. Which of the following problems cause improper vehicle tracking?
 - a. shifted rear housing
 - b. badly adjusted front street rod
 - c. bent wheel
 - d. bent frame

DEPT.	PRCG	DUTY	TASK	EN. OBJ.
IN	9043	F	02	1

SELF-CHECK

5
RVTC

7. If the left front coil spring is found to have sagged, you should:
 - a. adjust the sagging spring to proper height.
 - b. replace the sagging spring.
 - c. replace both front springs.
 - d. replace the left front and left rear spring.
8. When checking the wheel bearings, do all the following except:
 - a. feel the wheel assembly for looseness at the shock.
 - b. check the dial indicator reading.
 - c. look for free play between the spindle nut and wheel hub.
 - d. allow yourself to be confused by free play at the ball joint.
9. Two mechanics are discussing ball joint checks, Mechanic A says that most load-carrying ball joints need radial and axial measurements, but pivoting ball joints need visual checks. Mechanic B says that both load-carrying and pivoting ball joints need axial and radial measurements. Who is right?
 - a. Mechanic A only
 - b. Mechanic B only
 - c. Mechanic A and B
 - d. Neither A or B
10. When visually checking the control arm shims you should check all the following except:
 - a. cracks or damage to control arm.
 - b. looseness of control arm bolts.
 - c. fraying or cracking of control arm bushings.
 - d. improper lubrication of the inner shaft.
11. The condition of the strut rod and its bushing affects all the following except:
 - a. vehicle tracking.
 - b. front wheel alignment.
 - c. vehicle riding height.
 - d. vehicle braking force.
12. How much looseness can you allow on a tie rod end or ball-stud socket?
 - a. 0
 - b. 1/16
 - c. 1/8
 - d. 1/4

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	F	02	1

SELF-CHECK**RVTC**

13. If the inner ball-stud socket is worn, what should you replace?
- a. inner ball-stud socket
 - b. tie rod end
 - c. tie rod
 - d. tie rod adjusting sleeve
14. Which of the following do you need to check the steering gear mount for looseness?
- a. pry bar
 - b. shop towel
 - c. rubber hammer
 - d. box-end wrench
15. In Florida, how much steering lash is allowed for vehicles with wheels up to and including 18 inches in diameter?
- a. 3 inches of lash at the steering wheel
 - b. 2 inches of lash at the steering wheel
 - c. 1½ inches of lash at the steering wheel
 - d. no lash at the steering wheel

Now check your answers with the Answer Key.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	F	02	1

SELF-CHECK**RVTC**Answer Key

1. a, c, d
2. c
3. b
4. c
5. d
6. a, b, d
7. c
8. b
9. a
10. d
11. c
12. a
13. c
14. a
15. b

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	F	02	1

ENABLING OBJECTIVE NO. 2
RVTC

Service and adjust front wheel bearings.

LEARNING STEPS

1. View Resource No. 1 to identify the procedure for repacking wheel bearings.
2. Read Resource No. 2 to identify the procedure for testing and adjusting wheel bearings.
3. Read Resource No. 3 to identify the procedure for servicing, replacing or repacking bearings on drum brake wheels.
4. Using Resource No. 4, practice removing, installing and adjusting wheel bearings and seals.
5. Evaluate your knowledge by completing the Self-Check.
6. Go on to Enabling Objective No. 3.

RESOURCES

1. Bergwall Filmstrip/tape: No. 416.
2. Text: Steering, Suspension and Wheel Service, Unit 2, pages 19 - 32.
3. Text: Steering, Suspension and Wheel Service, Unit 2, pages 41 - 70.
4. Shop vehicle
5. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	02	2

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. Mechanic A says loose wheel bearings may cause excessive vibration when disc brakes are applied. Mechanic B says loose wheel bearings may cause excessive vibration when either disc or drum brakes are applied. Who is right?
 - a. mechanic A only
 - b. mechanic B only
 - c. both mechanics A and B
 - d. neither mechanic A nor B
2. Wheel bearings should be serviced after every:
 - a. 20,000 miles.
 - b. 22,000 miles.
 - c. 24,000 miles.
 - d. 26,000 miles.
3. Wheel bearings are usually adjusted when they are:
 - a. cleaned.
 - b. inspected.
 - c. repacked.
 - d. too loose or too tight.
4. Which of the following tools should be used to remove a cotter pin?
 - a. water pump pliers
 - b. diagonal pliers
 - c. dust cap remover
 - d. rubber hammer
5. To align the nut lock with the spindle hole you should:
 - a. remove the nut lock and re-position it.
 - b. move the spindle nut.
 - c. torque the spindle nut.
 - d. change the torque of the nut to match the locking hole.
6. What should you do if the threads at the end of the spindle are damaged while you are removing the drum brake hub?
 - a. rethread the spindle with a thread die
 - b. clean the spindle with a thread chaser
 - c. replace the spindle, it cannot be repaired
 - d. force the spindle nut on to clean out the threads

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	F	02	2

SELF-CHECK

RVTC

7. To clean and dry a cone and roller assembly, you should use:
 - a. gasoline.
 - b. cleaning solvent.
 - c. cleaning brush.
 - d. compressed air.
8. Mechanic A says spinning wheel bearings with compressed air is a good method of cleaning. Mechanic B says this is a dangerous practice and should never be done. Who is right?
 - a. mechanic A
 - b. mechanic B
 - c. both mechanic A and B
 - d. neither mechanic A nor B
9. The bearing cup has a hairline crack, but the cone and roller assembly are in good condition. Mechanic A says that the entire cup and bearing should be replaced, Mechanic B says only the cup should be replaced and the cone and roller assembly can be repacked and used again. Who is right?
 - a. mechanic A only
 - b. mechanic B only
 - c. both mechanic A and B
 - d. neither mechanic A nor B
10. The caliper assembly has been removed to repack the wheel bearings. Mechanic A says to let it hang from the brake hose to keep it out of the way. Mechanic B says to secure the caliper on the control arm. Who is right?
 - a. mechanic A only
 - b. mechanic B only
 - c. both mechanic A and B
 - d. neither mechanic A nor B

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	F	02	2

SELF-CHECK

RVTC

Answer Key

1. c
2. c
3. a, b, c, d
4. b
5. a
6. b
7. b, c, d
8. b
9. a
10. b

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	F	02	2

ENABLING OBJECTIVE NO. 3

RVTC

Remove and install spindle assembly and ball joints.

LEARNING STEPS

1. Read Resource No. 1 to identify the procedure for removing and installing spindle assembly and ball joint.
2. View Resource No. 2 to identify the ball joint theory and removal procedure.
3. Read and complete Resource No. 3 to practice removing the spindle and ball joint.
4. Complete Resource No. 4 to identify the procedure for removing ball joints from the control arms.
5. Read and complete Resource No. 5 to reassemble the spindle and ball joint.
6. Complete Resource No. 6 as a Self-Check.
7. Go on to Enabling Objective No. 4.

RESOURCES

1. Text: Steering, Suspension and Wheel Service, Unit 2, pages 93 - 96.
2. Hoffman slide/tape units: 3.7.A. and 3.7.B.
3. Text: Steering, Suspension and Wheel Service, Unit 2, pages 97 - 104.
4. a. Hoffman slide/tape units: 3.7.C. and 3.7.D.
b. Text: Steering, Suspension and Wheel Service, Unit 2, pages 104 - 107.
5. Text: Steering, Suspension and Wheel Service, Unit 2, pages 111 - 116.
6. Text: Steering, Suspension and Wheel Service, Unit 2, Exercise 6, page 100, Exercise 7, page 108 and Exercise 8, page 117.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	02	3

ENABLING OBJECTIVE NO. 4
RVTC

Remove and install shock absorbers.

LEARNING STEPS

1. View Resource No. 1 to identify the steps in removal and installation of shock absorbers.
2. Read and complete Resource No. 2 to identify the procedure to remove and install front shocks.
3. Read and complete Resource No. 3 to identify the steps in replacing the parts on Macpherson Strut-Suspension.
4. Complete Resource No. 4 as a Self-Check.
5. Using Resource No. 5 practice removing and installing shock absorbers.
6. Go on to Enabling Objective No. 5.

RESOURCES

1. Hoffman slide/tape unit: 3.3.D.
2. a. Text: Steering, Suspension and Wheel Service, Unit 2, pages 127 - 138.
b. Text: Steering, Suspension and Wheel Service, Review Exercise Book, Exercise 9, Questions 1 - 13, page 139.
3. Text: Steering, Suspension and Wheel Service, Unit 2, pages 148 - 150.
4. Text: Steering, Suspension and Wheel Service, Review Exercise Book, Exercise 11, page 151.
5. Text: Steering, Suspension and Wheel Service, Student Guide, Work Activity, Unit 2, page 153.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	02	4

ENABLING OBJECTIVE NO. 5
RVTC

Measure and adjust torsion bar height.

LEARNING STEPS

1. Read and complete Resource No. 1 describing measuring and adjusting torsion bars.
2. Complete Resource No. 2 as a Self-Check.
3. Using Resource No. 3, practice measuring and adjusting torsion bar height.
4. Go on to Enabling Objective No. 6.

RESOURCES

1. Text: Steering, Suspension and Wheel Service, Unit 2, pages 161 - 166.
2. Text: Steering, Suspension and Wheel Service, Review Exercise Book, Exercise 12, questions 1 - 13, page 167.
3. a. Text: Steering, Suspension and Wheel Service, Student Guide, Work Activity, page 170.
b. Practice vehicle

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	02	5

ENABLING OBJECTIVE NO. 6
RVTC

Replace front coil springs and torsion bars.

LEARNING STEPS

1. View Resource No. 1 identify the removal and installation of torsion bars.
2. Read Resource No. 2 describing the removal and replacement of torsion bars.
3. Complete Resource No. 3 as a Self-Check.
4. View Resource No. 4 to identify the steps in removing and installing coil springs.
5. Read and complete Resource No. No. 5 to identify the steps in removing and replacing coil springs.
6. Complete Resource No. 6 as a Self-Check.
7. Using Resource No. 7 practice replacing front coil springs and torsion bars.
8. Go on to Enabling Objective No. 7.

RESOURCES

1. Hoffman slide/tape unit: 3.3.C.
2. Text: Steering, Suspension and Wheel Service, Unit 2, pages 193 - 196.
3. Text: Steering, Suspension and Wheel Service, Review Exercise Book, Exercise 14, page 197.
4. Hoffman slide/tape unit: 3.3.B.
5. Text: Steering, Suspension and Wheel Service, page 179 - 188.
6. Text: Steering, Suspension and Wheel Service, Review Exercise Book, Exercise 13, question 1 - 14, page 189.
7. a. Text: Steering, Suspension and Wheel Service, Student Guide, Work Activity, items 1 - 12, page 192.
b. Practice vehicle

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	02	6

ENABLING OBJECTIVE NO. 7
RVTC

Replace front suspension control arms and bushings.

LEARNING STEPS

1. Read Resource No. 2 to identify the procedure for replacing front suspension control arms and bushings.
2. Complete Resource No. 2 as a Self-Check.
3. Using Resource No. 3, practice replacing front suspension control arms and bushings.
4. Go on to Enabling Objective No. 8.

RESOURCES

1. Text: Steering, Suspension and Wheel Service, pages 205 - 217.
2. Text: Steering, Suspension and Wheel Service, Student Guide, Review Exercise Book, Exercise 15, questions 1 - 18, page 218.
3. Text: Steering, Suspension and Wheel Service, Student Guide, Work Activity, items 1 - 12, page 222.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	02	7

ENABLING OBJECTIVE NO. 8
RVTC

Replace steering linkage components and dampers.

LEARNING STEPS

1. Read Resource No. 1 to identify the steps in replacing steering linkage components and dampers.
2. View Resource No. 2 or read Resource No. 2 describing replacement of tie rod ends and steering arms.
3. Complete Resource No. 3 as a Self-Check.
4. Read and complete Resource No. 4 to identify the steps in replacing idler arms and bushings.
5. Using Resource No. 5, practice replacing steering linkage components and dampers.
6. See your instructor before going on to Enabling Objective No. 9.

RESOURCES

1. Text: Steering, Suspension and Wheel Service, Unit 2, pages 233 - 235.
2. a. Hoffman slide/tape unit: 3.7.E.
b. Text: Steering, Suspension and Wheel Service, Unit 2, pages 236 - 238.
3. Text: Steering, Suspension and Wheel Service, Review Exercise Book, Exercise 16, questions 1 - 6, page 239.
4. a. Text: Steering, Suspension and Wheel Service, Unit 2, pages 242 - 266.
b. Text: Steering, Suspension and Wheel Service, Review Exercise Book, Exercise 17, questions 1 - 10, page 253.
5. Text: Steering, Suspension and Wheel Service, Student Guide, Work Activity, pages 241, 256 and 267.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	02	8

ENABLING OBJECTIVE NO. 9
RVTC

Diagnose and repair front end.

LEARNING STEPS

1. Obtain Resource No. 1 to practice diagnosing and repairing a front end.
2. Complete Resource No. 2 before any repairs are made.
3. Complete Resource No. 3 to practice removing and installing parts of the front end.
4. When you think you can attain this task, take the Written Test.
5. When you successfully complete the Written Test, take the Performance Test.

RESOURCES

1. Practice vehicle with worn or damaged front end parts.
2. Inspection Report
3. Practice vehicle
4. Written Test for task F-02.
5. Performance Test for task F-02.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	02	9

WRITTEN TEST FOR TASK NO. F-02

RVTC

IN-9043-F-02

TASK:

Diagnose and Repair Front End

Test No. 1

DirectionsPAGE 1 OF 4

The purpose of this test is to determine if you can diagnose and repair front end. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Multiple Choice. On the separate Answer Sheet, put the letter of the correct answer on the line to the left of the number of the question.

DO NOT MARK ON THIS TEST!

Multiple Choice questions

1. Where should you put the tire tread depth gauge to check tread wear?
 - a. near the center rib of the tire
 - b. at the rib near the edge of the tire
 - c. at the place where the rib looks most worn
 - d. at the rib about 1/32 inch from the outer edge of the tire
2. When you alternately push the wheel in and pull it out, you feel looseness. What could cause this looseness?
 - a. loose wheel bearings
 - b. ball joints
 - c. loose tie rod ends
 - d. all the above
3. You have checked the lower control arms and found the mounting bolts are loose. You should note the lower control arm:
 - a. bolts need replacement.
 - b. bolts need tightened.
 - c. needs replacement.
 - d. bushings need replacement.
4. While checking the idler arm you find it has 1/32 inch of play. You should:
 - a. replace the idler arm.
 - b. replace the idler arm support bracket.
 - c. tighten the ball-stud socket.
 - d. not replace the idler arm.

DEPT.	PROG.	DUTY	TASK
IN	9043	F	02

WRITTEN TEST FOR TASK NO. F-02

RVTC

IN-9043-F-02

TASK:

Diagnose and Repair Front End

PAGE 2 OF 4

5. With the front wheels in the straight ahead position. How much free play is in the steering wheel?
 - a. 0
 - b. 1 inch
 - c. 2 inches
 - d. 3 inches
6. Loose steering can be caused by all the following items except:
 - a. loose wheel bearings.
 - b. loose steering gear adjustment.
 - c. loose pump belt tension.
 - d. loose power cylinder mounting.
7. Loose wheel bearings may cause **all the following** except:
 - a. faster tire wear.
 - b. loose steering.
 - c. braking vibrations.
 - d. squeal on drums.
8. When removing a cotter pin you should use:
 - a. a rubber hammer.
 - b. a wire cutter..
 - c. water pump pliers.
 - d. diagonal pliers.
9. The spec book recommends 240 in. lbs. of torque. How many foot lbs. of torque would this be?
 - a. 1 ft. lbs.
 - b. 12 ft. lbs.
 - c. 20 ft. lbs.
 - d. 24 ft. lbs.
10. Before removing front brake pads, you should be sure the master cylinder fluid level is:
 - a. half full.
 - b. filled to the top.
 - c. filled $\frac{1}{4}$ from the top.
 - d. empty.

DEPT.	PROG.	DUTY	TASK
IN	9043	F	02

WRITTEN TEST FOR TASK NO. F-02

RVTC

IN-9043-F-02

TASK:

Diagnose and Repair Front End

PAGE 3 OF 4

11. Mechanic A says the steering will be loose if the ball joints are loose or worn. Mechanic B says the vehicle will have poor front end alignment if the ball joints are loose or worn. Who is right?
- mechanic A only
 - mechanic B only
 - both mechanic A and B
 - neither mechanic A nor B
12. To remove the spindle assembly you should do all the following except:
- loosen the ball joints.
 - remove the ball joint cutter pins.
 - remove the ball joint retaining nuts.
 - install a ball-stud remover between the upper and lower ball joints.
13. Mechanic A says to use a 1/8 inch drill bit to drill through the riveted head of a riveted ball joint to remove it. Mechanic B says to use the size drill bit that will completely cut off the head of the rivet. Who is right?
- mechanic A only
 - mechanic B only
 - both mechanic A and B
 - neither mechanic A nor B
14. Read the following statements about releasing the front shocks.
- Remove the upper retaining bolts first, and then remove the lower mounting bolts.
 - Remove the bracket assembly first, then remove the shock absorber. Which is correct?
- 1 only
 - 2 only
 - either 1 or 2
 - neither 1 nor 2
15. The left front shock is leaking, Mechanic A says to replace only the leaking shock, Mechanic B says both the right and left shock should be replaced to give equal riding control. Who is right?
- mechanic A only
 - mechanic B only
 - both mechanic A and B
 - neither mechanic A nor B

DEPT.	PROG.	DUTY	TASK
IN	9043	F	02

WRITTEN TEST FOR TASK NO. F-02

RVTC

IN-9043-F-02

TASK:

Diagnose and Repair Front End

PAGE 4 OF 4

16. Mechanic A says that after front shocks have been installed on MacPherson strut type suspension, the alignment must be checked. Mechanic B says this is not necessary because the removing and installing of shocks will not affect alignment on this type of suspension. Who is right?
- mechanic A only
 - mechanic B only
 - mechanic A and B
 - neither A nor B
17. All the following tools will help you adjust torsion bars except:
- ratchet and socket.
 - tape measure.
 - torsion bar height gauge.
 - run out gauge.
18. When installing a coil spring compressor, you should insert the upper and lower compressor plates as close as possible to:
- the middle of the coil spring.
 - each end of the coil spring.
 - the upper end of the coil spring.
 - the lower end of the coil spring.
19. Which of the following tools are used to install control arm bushing?
- air hammer and chisel
 - bushing expander
 - ball stud remover
 - C-clamp
20. After removing the retaining nut and washer from the pitman arm, a mechanic should remove the pitman arm from the sector by:
- tapping it with a ball peen hammer and brass drift.
 - loosening it with an air hammer and chisel.
 - tightening the pitman arm puller until the pitman arm pulls free.
 - twisting the sector shaft counterclockwise.

DEPT.	PROG.	DUTY	TASK
IN	9043	F	02

WRITTEN TEST FOR TASK NO. F-02

RVTC

IN-9043-F-02

TASK:

Diagnose and Repair Front End

Test No. 1

ANSWER KEY

PAGE 1 OF 1Multiple Choice questions

- | | | | | |
|-------------|--------------|--------------|--------------|-----------------|
| <u>c</u> 1. | <u>c</u> 6. | <u>c</u> 11. | <u>a</u> 16. | <u> </u> 21. |
| <u>d</u> 2. | <u>d</u> 7. | <u>a</u> 12. | <u>d</u> 17. | <u> </u> 22. |
| <u>b</u> 3. | <u>d</u> 8. | <u>c</u> 13. | <u>b</u> 18. | <u> </u> 23. |
| <u>c</u> 4. | <u>c</u> 9. | <u>c</u> 14. | <u>a</u> 19. | <u> </u> 24. |
| <u>a</u> 5. | <u>a</u> 10. | <u>b</u> 15. | <u>c</u> 20. | <u> </u> 25. |

True-False questions

- | | | | | |
|--------|---------|---------|---------|---------|
| T F 1. | T F 6. | T F 11. | T F 16. | T F 21. |
| T F 2. | T F 7. | T F 12. | T F 17. | T F 22. |
| T F 3. | T F 8. | T F 13. | T F 18. | T F 23. |
| T F 4. | T F 9. | T F 14. | T F 19. | T F 24. |
| T F 5. | T F 10. | T F 15. | T F 20. | T F 25. |

Matching questions

- | | | | | |
|----------------|-----------------|-----------------|-----------------|-----------------|
| <u> </u> 1. | <u> </u> 6. | <u> </u> 11. | <u> </u> 16. | <u> </u> 21. |
| <u> </u> 2. | <u> </u> 7. | <u> </u> 12. | <u> </u> 17. | <u> </u> 22. |
| <u> </u> 3. | <u> </u> 8. | <u> </u> 13. | <u> </u> 18. | <u> </u> 23. |
| <u> </u> 4. | <u> </u> 9. | <u> </u> 14. | <u> </u> 19. | <u> </u> 24. |
| <u> </u> 5. | <u> </u> 10. | <u> </u> 15. | <u> </u> 20. | <u> </u> 25. |

DEPT.	PROG.	DUTY	TASK
IN	9043	F	02

WRITTEN TEST FOR TASK NO. F-02

RVTC

IN-9043-F-02

TASK:

Diagnose and Repair Front End

Test No. 2

DirectionsPAGE 1 OF 4

The purpose of this test is to determine if you can diagnose and repair front end. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Multiple Choice. On the separate Answer Sheet, put the letter of the correct answer on the line to the left of the number of the question.

DO NOT MARK ON THIS TEST!

Multiple Choice questions

1. The upper and lower control arm of an Independent Front Suspension is:
 - a. welded to the frame of the car.
 - b. bolted to the frame of the car.
 - c. permanently connected to the steering knuckle.
 - d. directly connected to each other.
2. Which of the following parts listed carry the weight of the tie rods and the intermediate rod?
 - a. the idler arm
 - b. the pitman arm
 - c. the steering arms
 - d. all of the above
3. A vehicle driven with improper camber angles will:
 - a. tend to wear tires unevenly
 - b. pull sharply to the right when the brakes are applied
 - c. pull sharply to the left when the brakes are applied
 - d. cause a bad shimmy at about 10 miles per hour
4. Most front end problems are a result of:
 - a. poor workmanship at the factory
 - b. high speed driving
 - c. low speed driving
 - d. improper alignment or worn parts

DEPT.	PROG.	DUTY	TASK
IN	9043	F	02

WRITTEN TEST FOR TASK NO. F-02

RVTC

IN-9043-F-02

TASK:

Diagnose and Repair Front End

PAGE 2 OF 4

5. The front end wanders. It is difficult to steer it straight. What would you look for?
 - a. excessive toe-in of the front wheels
 - b. excessive looseness in the steering mechanism
 - c. a binding of one or more of the steering mechanisms pivots
 - d. all of the above
6. A tire is worn smooth on one side what is wrong with the front end?
 - a. the caster is off
 - b. the camber is off
 - c. the toe-in is off
 - d. the toe-out is off
7. A tire that shows signs of being cupped is the result of:
 - a. an unbalanced condition of tires
 - b. poor wheel alignment
 - c. bad brakes
 - d. all of the above
8. What is Axial Tolerance?
 - a. an axle that is slightly worn
 - b. the allowable up and down movement of front ball joints
 - c. a front axle that can be substituted for an independent front suspension
 - d. a special front suspension used on foreign cars
9. Which front end part(s) must be disconnected in order to remove a lower ball joint?
 - a. the pitman arm from the intermediate arm
 - b. the idler arm from the tie rod
 - c. the tie rod end from the steering arm
 - d. all of the above must be removed
10. Before a new lower ball joint is installed:
 - a. clean the end of the lower control arm.
 - b. compare it with one that was removed.
 - c. locate it in the correct position.
 - d. all of the above.

DEPT.	PROG.	DUTY	TASK
IN	9043	F	02

WRITTEN TEST FOR TASK NO. F-02

RVTC

IN-9043-F-02

TASK:

Diagnose and Repair Front End

PAGE 3 OF 4

11. A replacement ball joint must always be refastened with (by):
 - a. new rivets.
 - b. the same cap screws that were removed.
 - c. a new set of cap screws.
 - d. welding them in place.
12. Which of the following tools is recommended to tighten ball joints?
 - a. a 3/8" drive ratchet and socket
 - b. a 1/2" drive ratchet and socket
 - c. a 1/2" torque wrench and socket
 - d. an open wrench
13. Why is it better to connect the upper ball joint first during the reassembly of a ball joint job?
 - a. to prevent the drum assembly from falling
 - b. to protect the brake line from damage
 - c. to help in locating the position of the lower ball joint
 - d. all of the above
14. Which of the following locking devices uses a cotter pin?
 - a. a double-nut
 - b. a pal nut
 - c. a self locking nut
 - d. none of the above
15. A good trade practice during a ball joint replacement job should include:
 - a. relining of the brakes.
 - b. rebuilding from brake wheel cylinders.
 - c. complete tightening of the entire front end.
 - d. none of the above.
16. One of the following is a very important step, following the replacement of a ball joint:
 - a. adjust the ball joint.
 - b. lubricate it with chassis grease.
 - c. repacking it by hand with wheel bearing grease.
 - d. all of the above.

DEPT.	PROG.	DUTY	TASK
IN	9043	F	02

WRITTEN TEST FOR TASK NO. F-02

RVTC

IN-9043-F-02

TASK:

Diagnose and Repair Front End

PAGE 4 OF 4

17. Which of the following is a safe procedure for replacement of front wheels?
- jack up the car, remove the horses, replace the wheels
 - snug up the wheels, remove the horses, tighten wheels on the ground
 - tighten wheels, remove horses, lower the car
 - any of the above
18. At the completion of a ball joint installation, which of the following should be done?
- a camber adjustment
 - a caster adjustment
 - a toe-in adjustment
 - all of the above
19. What causes a wheel to "run-out"?
- a worn upper ball joint
 - a worn lower ball joint
 - a bent wheel or drum
 - a bent steering arm
20. A mechanic is measuring the wheel base on both sides of the vehicle. What is he checking for?
- to see if the wheels are tracking correctly
 - toe in of the front wheels
 - toe in of the rear wheels
 - toe out of the front wheels

DEPT.	PROG.	DUTY	TASK
IN	9043	F	02

WRITTEN TEST FOR TASK NO. F-02

RVTC

TASK:

Diagnose and Repair Front End

Test No. 2

ANSWER KEY

PAGE 1 OF 1Multiple Choice questions

- | | | | | |
|-------------|--------------|--------------|--------------|-----------------|
| <u>b</u> 1. | <u>b</u> 6. | <u>c</u> 11. | <u>b</u> 16. | <u> </u> 21. |
| <u>d</u> 2. | <u>a</u> 7. | <u>c</u> 12. | <u>b</u> 17. | <u> </u> 22. |
| <u>a</u> 3. | <u>b</u> 8. | <u>d</u> 13. | <u>d</u> 18. | <u> </u> 23. |
| <u>d</u> 4. | <u>c</u> 9. | <u>d</u> 14. | <u>c</u> 19. | <u> </u> 24. |
| <u>d</u> 5. | <u>d</u> 10. | <u>c</u> 15. | <u>a</u> 20. | <u> </u> 25. |

True-False questions

- | | | | | |
|--------|---------|---------|---------|---------|
| T F 1. | T F 6. | T F 11. | T F 16. | T F 21. |
| T F 2. | T F 7. | T F 12. | T F 17. | T F 22. |
| T F 3. | T F 8. | T F 13. | T F 18. | T F 23. |
| T F 4. | T F 9. | T F 14. | T F 19. | T F 24. |
| T F 5. | T F 10. | T F 15. | T F 20. | T F 25. |

Matching questions

- | | | | | |
|----------------|-----------------|-----------------|-----------------|-----------------|
| <u> </u> 1. | <u> </u> 6. | <u> </u> 11. | <u> </u> 16. | <u> </u> 21. |
| <u> </u> 2. | <u> </u> 7. | <u> </u> 12. | <u> </u> 17. | <u> </u> 22. |
| <u> </u> 3. | <u> </u> 8. | <u> </u> 13. | <u> </u> 18. | <u> </u> 23. |
| <u> </u> 4. | <u> </u> 9. | <u> </u> 14. | <u> </u> 19. | <u> </u> 24. |
| <u> </u> 5. | <u> </u> 10. | <u> </u> 15. | <u> </u> 20. | <u> </u> 25. |

DEPT.	PROG.	DUTY	TASK
IN	9043	F	02

PERFORMANCE TEST FOR TASK NO. F-02

RVTC

TASK:

Diagnose and Repair Front End

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will diagnose and repair front end. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO		
1.	Was vehicle placed on lift or jack in a secure, safe position?				
2.	Was inspection report completed?				
3.	Were all needed repairs listed on the inspection report?				
4.	Were all needed repairs noted?				
5.	Was repair manual for the test vehicle used?				
6.	Were other parts kept from damage during the process of repair?				
7.	Were all parts cleaned before reassembly?				
8.	Were safety glasses worn during repairs?				
9.	Was vehicle clean of grease and ready for alignment?				
10.	Was student capable of removing and installing all needed parts without help?				
☐ ATTAINED ☐ NOT ATTAINED		EVALUATOR'S SIGNATURE _____ _____			
DEPT.	PROG.	DUTY	TASK	ATTEMPT	Page <u>1</u> of <u>1</u>
IN	9043	F	02		

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7700 State Road 544 N
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IN-9043-F-01

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Identify Steering System Components

DUTY:

Repairing and Maintaining Front End

PURPOSE :

You must be able to identify the components of the steering system in order to make repairs. As a mechanic, you will be required to locate specific components and service them.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	F	01	

REVISED

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

GIVEN: access to steering system,

YOU WILL: identify the steering system components.

HOW WELL: Your performance will be assessed by your instructor using the Performance Test on page 7.

ENABLING OBJECTIVES:

1. Identify steering system components.
2. Identify steering system.

DEPT.	PROG.	DUTY	TASK
IN	9043	F	01

ENABLING OBJECTIVE NO. 1

RVTC

Identify steering system components.

LEARNING STEPS

1. View Resource No. 1 to identify the parts of the front end.
2. Evaluate your knowledge by completing the Self-Check.
3. Go on to Enabling Objective No. 2.

RESOURCES

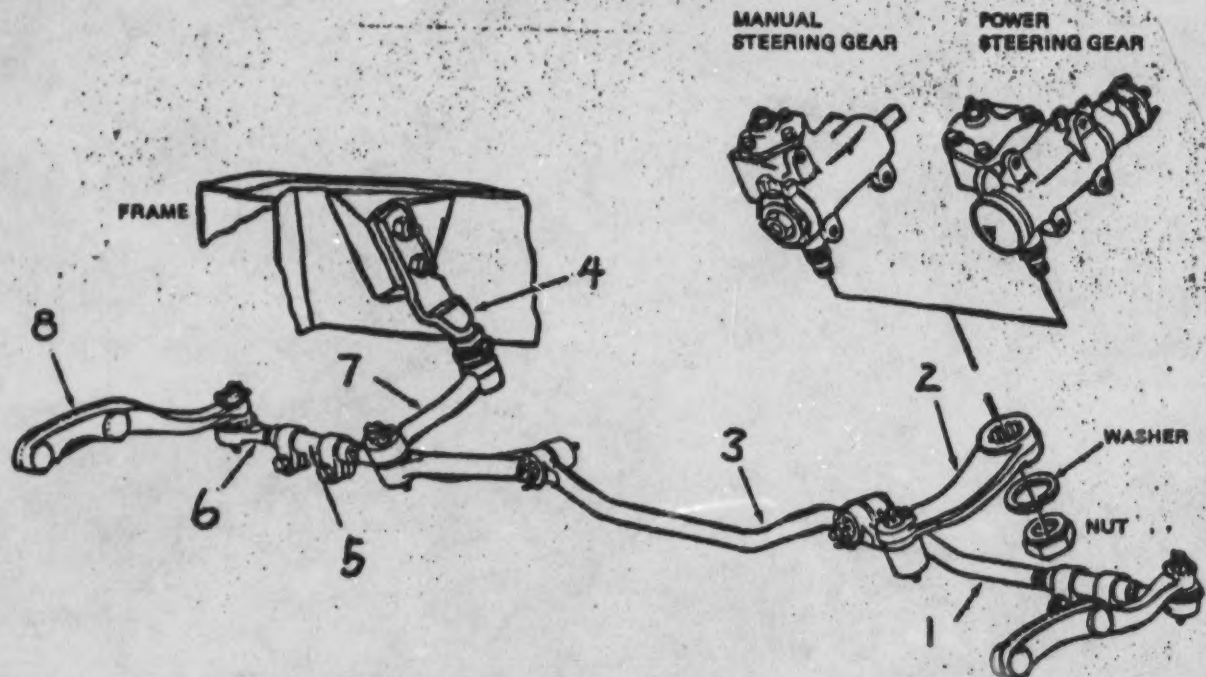
1. a. Bergwall film/tape: 403.
b. Front end shop display
2. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	01	1

SELF-CHECK

RVTC

Directions



- a. intermediate rod
- b. steering arm
- c. idler arm support
- d. tie rod end
- e. tie rod
- f. pitman arm

- g. idler arm
- h. tie-in adjusting sleeve

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	F	01	1

SELF-CHECK

5

RVTC

Answer Key

1. e
2. f
3. a
4. c
5. h
6. d
7. g
8. b

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	01	1

ENABLING OBJECTIVE NO. 2

RVTC

Identify steering system.

LEARNING STEPS

1. View Resource No. 1 to identify the steering and front suspension system components.
2. Practice identifying the steering system components using Resource No. 2.
3. When you think you can perform this task, take the Performance Test.

RESOURCES

1. Hoffman slide/tape units: 3.2.A, 3.2.B, 3.3.C.
2. Shop vehicle or front end shop display.
3. Performance Test for task F-01

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	F	01	1

PERFORMANCE TEST FOR TASK NO. F-01

RVTC

IN-9043-F-01

TASK:

Identify Steering System Components

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will identify steering system Components. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Were adjusting sleeves identified?		
2.	Were tie rod ends identified?		
3.	Was intermediate rod identified?		
4.	Was pitman arm identified?		
5.	Was steering arm identified?		
6.	Was idler arm identified?		
7.	Was tie rod identified?		
8.	Was steering gear identified?		

☐ ATTAINED
☐ NOT ATTAINED

Score _____

DEPT.	PROG.	DUTY	TASK	ATTEMPT
IN	9043	F	01	

EVALUATOR'S SIGNATURE _____
 Page 1 of 1

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IN-9043-E-03

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Diagnose and Repair Power Brake Assembly

DUTY:

Repairing and Maintaining Brakes

PURPOSE :

Power boosters are used on almost every intermediate and full size vehicle made today. It is important for the mechanic to be able to diagnose and repair a power brake assembly. The mechanic should make any other repairs needed on the brake system to insure a complete job.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	E	03	

REVISED				

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

- GIVEN:** tools, equipment and a power brake assembly,
- YOU WILL:** diagnose and repair a power brake assembly.
- HOW WELL:** Your performance will be assessed by your instructor using the Performance Test on page 13.

ENABLING OBJECTIVES:

1. Describe the procedure for diagnosing a power brake assembly.
2. Describe the procedure for repairing a power brake assembly.
3. Diagnose and repair a power brake assembly.

DEPT.	PROG.	DUTY	TASK
IN	9043	E	03

ENABLING OBJECTIVE NO. 1

3
RVTC

Describe the procedure for diagnosing a power brake assembly.

LEARNING STEPS

1. Read Resource No. 1 to describe the procedure for diagnosing a power brake assembly.
2. View Resource No. 2 to identify the operation of the power booster.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. a. Text: Crouse Automotive Mechanics, pages 560-562.
b. Text: Brakes, pages 13-3 to 13-8.
2. Hoffman slide/tape unit: 5.1.B.
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	E	03	1

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by matching the items below on a separate sheet of paper.

Control Valves

vacuum valve atmospheric valve

1. OPEN OPEN

2. CLOSED CLOSED

3. OPEN CLOSED

4. CLOSED OPEN

Booster Position

a. released position

b. applied position

c. holding position

d. defective valve or vacuum leak.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	03	1

SELF-CHECK**RVTC**Answer Key

1. d
2. c
3. a
4. b

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	E	03	1

ENABLING OBJECTIVE NO. 2

RVTC

Describe the procedure for repairing a power brake assembly.

LEARNING STEPS

1. Read Resource No. 1 to describe the procedure for repairing a power brake assembly.
2. Read Resource No. 2 to describe the procedure for removing and installing a power brake assembly.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 3.

RESOURCES

1. a. Text: Crouse Automotive Mechanics, page 560-562.
b. Text: Brakes, pages 13-4, 13-5 and 13-6.
2. Instruction Sheet enclosed, Removal and Installation of Power Booster
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	E	03	2

INSTRUCTION SHEET

7
RVTC

PAGE 1 OF 1

Removal and Installation of Power Booster

NOTE: Consult the manufacturer's manual before removing, installing and/or adjusting a typical vacuum booster. The following is a general outline.

1. Remove the bolts or nuts that secure the master cylinder to the booster.

NOTE: On most automobiles the brake lines do not have to be disconnected, use care not to kink the lines.

2. Disconnect vacuum hoses.
3. Remove the retainer which secures the valve rod to the brake pedal.
4. Remove the bolts or nuts which secure the booster to the firewall.
5. Remove the booster by lifting upward and forward.
6. Check the pushrod length and adjust to the vehicle specifications. If the pushrod is too long the master cylinder will have no free play and the brakes will drag or lock. If the rod is too short the travel is not sufficient for maximum braking operation. Use the pushrod gauge for this adjustment.

Installation of Power Boosters

1. Place the booster in position on firewall.

2. Start the bolts or nuts.

NOTE: Be sure the operating rod is lined with pedal linkage.

3. Tighten bolts or nuts.
4. Install the retainer which connects the valve rod to the pedal linkage.
5. Install vacuum hoses.
6. Place the master cylinder on the front of the booster.
7. If any brake lines were removed the brakes must be bled.
8. Test the operation of the booster unit.

DEPT.	PROG.	DUTY	TASK	EN OBJ.
IN	9043	E	03	2

SELF-CHECK

RVTC

Directions

Evaluate your work by putting the letter of the correct answer on a separate sheet of paper.

1. When the engine was started the brake pedal dropped slightly, this is an indication that the brake booster:
 - a. atmospheric valve is stuck.
 - b. vacuum valve is stuck.
 - c. needs replacing.
 - d. is in good condition.
2. Good power brake action is directly related to engine:
 - a. power.
 - b. rpm.
 - c. vacuum.
 - d. temperature.
3. The use of the pushrod gauge is to insure proper:
 - a. brake pedal free play.
 - b. master cylinder free play.
 - c. vacuum to the booster.
 - d. all of the above.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	03	2

SELF-CHECK

RVTC

Answer Key

1. d
2. c
3. b

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	03	2

ENABLING OBJECTIVE NO. 3

RVTC

Diagnose and repair a power brake assembly.

LEARNING STEPS

1. Review Resources to identify the steps to diagnose and repair a power brake assembly.
2. Practice diagnosing and repairing a power brake assembly.
3. Evaluate your knowledge by completing the Self-Check.
4. When you think you can perform this task, take the Performance Test.

RESOURCES

1. a. Text: Brakes, pages 13-4 to 13-10.
b. Text: Crouse Automotive Mechanics, pages 560-562.
c. National Service Data Shop Manuals
2. a. Power brake components
b. Service manual
3. Self-Check enclosed.
4. Performance Test for task E-03.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	E	03	3

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. Disc brakes do not use brake drums or brake shoes.
2. Dual brake systems have the same master cylinder as conventional brake systems.
3. Mineral spirits is a recommended lubricant for brake components.
4. Power brakes use vacuum or pressure from the engine to operate.
5. All seals should be coated with brake fluid before installing the master cylinder bore.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	03	3

SELF-CHECK

RVTC

Answer Key

1. T
2. F
3. F
4. T
5. F

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	03	3

PERFORMANCE TEST FOR TASK NO. E-03

RVTC

TASK:

Diagnose and Repair Power Brake Assembly

IN-9043-E-03

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: In a shop situation, you will diagnose and repair the power brake assembly on an assigned vehicle. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO										
1.	Was the work order read?.....												
2.	Was the procedure for diagnosing the power brake assembly followed?.....												
3.	Were worn parts identified and replaced?.....												
4.	Was the disassembly procedure followed?.....												
5.	Were worn parts repaired and replaced?.....												
6.	Was the assembly procedure followed?.....												
7.	Was the brake system bled, if required?.....												
8.	Was the vehicle tested to check the brake operation?.....												
9.	Was the brake fluid cleaned from the vehicle?.....												
Score _____ ☐ ATTAINED ☐ NOT ATTAINED EVALUATOR'S SIGNATURE _____ <table border="1" style="width: 100%; margin-top: 5px;"> <thead> <tr> <th>DEPT.</th> <th>PROG.</th> <th>DUTY</th> <th>TASK</th> <th>ATTEMPT</th> </tr> </thead> <tbody> <tr> <td>IN</td> <td>9043</td> <td>E</td> <td>03</td> <td></td> </tr> </tbody> </table> Page <u>1</u> of <u>1</u>				DEPT.	PROG.	DUTY	TASK	ATTEMPT	IN	9043	E	03	
DEPT.	PROG.	DUTY	TASK	ATTEMPT									
IN	9043	E	03										

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IN-9043-E-02

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Recondition Brake System

DUTY:

Repairing and Maintaining Brakes

PURPOSE :

The proper repair and operation of brakes depends upon careful reconditioning of the brakes. The procedures for reconditioning either drum or disc brakes will be outlined in this Learning Guide.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	E	02	E-01

REVISED

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:****GIVEN:** 1978 Chevy test vehicle and access to tool room,**YOU WILL:** recondition brake system.**HOW WELL:** Your performance will be assessed by your instructor using the Performance Test on page 20.**NOTE:**

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Disassemble drum brakes and hardware.
2. Disassemble disc brakes and hardware.
3. Service brake components and hardware.
4. Reassemble drum brakes and hardware.
5. Reassemble disc brakes and hardware.

DEPT.	PROG.	DUTY	TASK
IN	9043	E	02

ENABLING OBJECTIVE NO. 1

RVTC

Disassemble drum brakes and hardware.

LEARNING STEPS

1. Read Resource No. 1 to identify the procedure for disassembling drum brakes and hardware.
2. Using Resource No. 2, practice disassembling drum brakes.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. a. Instruction Sheet enclosed, Disassembling Drum Brakes
b. Repair Manual
2. 1978 Chevy test vehicle
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	E	02	1

INSTRUCTION SHEET

RVTC

PAGE 1 OF 1Disassembling Drum Brakes

1. Secure repair manual for make, model and year of the vehicle.
2. Place a work bench in an area close to the vehicle for component and hardware layout.
3. Lift and secure vehicle at a comfortable working height.
4. Follow procedures in the repair manual to disassemble the wheel assembly.
5. Remove the brake drum. It may be necessary to rotate the star-wheel to loosen shoe-to-drum clearance to remove the drum.
6. Layout the wheel assembly components and all other components related to the completion of the task and arrange them so they can be reassembled in the reverse order.
7. Do not attempt to disassemble both sides (left & right) before you are able to reassemble the same side.
8. At this point determine which hardware components are serviceable and which are not.
9. Follow the repair manual steps for the removal of the brake shoe, springs, starwheel and the other brake hardware.
10. Layout the brake shoes and hardware as they were mounted on the backing plate.
11. You are now ready to clean and service the brake components and hardware.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	02	1

SELF-CHECK

RVTC

Directions

Evaluate your work by answering the items below.

All items should receive a "YES" response.

- | | <u>YES</u> | <u>NO</u> |
|---|------------|-----------|
| 1. Were safety glasses worn?..... | ___ | ___ |
| 2. Was vehicle secured on lift?..... | ___ | ___ |
| 3. Was repair manual used?..... | ___ | ___ |
| 4. Was wheel assembly laid out correctly?..... | ___ | ___ |
| 5. Was disassembly procedure followed as outlined in
repair manual?..... | ___ | ___ |
| 6. Were unserviceable components detected?..... | ___ | ___ |
| 7. Were brake shoes and hardware laid out correctly?..... | ___ | ___ |

If you received a "NO" response for any item, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	02	1

ENABLING OBJECTIVE NO. 2
RVTC

Disassemble disc brakes and hardware.

LEARNING STEPS

1. Read Resource No. 1 to identify the procedure for disassembling disc brakes and hardware.
2. Using Resource No. 2, practice disassembling disc brakes.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 3.

RESOURCES

1. Instruction Sheet enclosed, Disassembling Disc Brakes
2. 1978 Chevy test vehicle
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	E	02	2

INSTRUCTION SHEET

RVTC

PAGE 1 OF 1Disassembling Disc Brakes

1. Secure repair manual for make, model, and year of vehicle.
2. Place a work bench in an area close to the vehicle for component and hardware layout.
3. Lift and secure vehicle at a comfortable working height and set fender covers in place.
4. Usually the first step would be to remove some of the brake fluid from the reservoir to prevent fluid from spilling when the pistons are pushed into the cylinder to provide clearance for pad removal and replacement.
5. Most calipers will disconnect by first removing the attaching bolts, retainer pins or guide pins.

NOTE: Follow the specific procedures in the repair manual for this step.

6. If the caliper is to be serviced or rebuilt, the hose lines will have to be disconnected and positioned so that brake fluid will not run out. If the caliper is not to be repaired or serviced it may be secured so that the weight of the caliper will not damage the flexible brake line or hose.
7. The caliper is then clamped with a C-clamp so that the clamp will force the piston inward to provide the clearance necessary for caliper removal.

NOTE: This procedure may or may not be needed; check repair manual for details.

8. The brake pads are usually retained in the caliper housing. They may be held with a retainer clip, pin or by closely fitting tabs on the shoe that are bent over the shoulder of the caliper. Here again the repair manual will give you the specifics.
9. Removal of these pins, clips or tabs will allow the pads to be lifted out of the caliper.
10. Remove the rotor and prepare all its components for cleanup and inspection.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	02	2

SELF-CHECK

RVTC

Directions

Evaluate your work by answering the items below.

All items should receive a "YES" response.

- | | <u>YES</u> | <u>NO</u> |
|--|------------|-----------|
| 1. Were safety glasses worn?..... | ___ | ___ |
| 2. Was vehicle secured on the lift?..... | ___ | ___ |
| 3. Was repair manual used?..... | ___ | ___ |
| 4. Was wheel assembly laid out correctly?..... | ___ | ___ |
| 5. Was disassembly procedure followed as outlined in the repair manual?..... | ___ | ___ |
| 6. Were unserviceable components detected?..... | ___ | ___ |
| 7. Were brake pads and hardware laid out correctly?..... | ___ | ___ |
| 8. Were correct tools used to disassemble caliper and pads?..... | ___ | ___ |

If you received a "NO" response for any item, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	02	2

ENABLING OBJECTIVE NO. 3

RVTC

Service brake components and hardware.

LEARNING STEPS

1. View Resource No. 1 to identify the procedure for cleaning and servicing brake components and hardware.
2. Read Resource No. 2 to identify the procedure for preparing components to be reassembled.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 4.

RESOURCES

1. Bergwall Filmstrip/tape: Parts 4 and 6, No. 404.
2. Instruction Sheet enclosed, Preparing Components for Re-assembly
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	E	02	3

INSTRUCTION SHEET

RVTC

PAGE 1 OF 1Preparing Components for Reassembly

After proper inspection you should determine whether or not a brake component is serviceable, should be rebuilt, or replaced. Master cylinders, wheel cylinders, rotors, drums and calipers are among the components to be determined serviceable or unserviceable.

Master cylinder: The master cylinder is not commonly rebuilt. Problems with the master cylinder which require service or replacement fall into two areas: external leakage and internal leakage. The external leak will usually show up on the cowl panel or on the front side of the power booster.

The internal leaks may occur past the primary cup, secondary cup, inverted secondary cup and seals result in either pedal fade, reservoir leakage from one chamber to the other and overflowing of one of the two chambers.

If any of the above conditions exist, obtain the proper repair manual and follow the removal, disassembly and reassembly procedures for the master cylinder you are using.

Wheel cylinder: The wheel cylinders will require service if a leakage of fluid is detected around the boot and also if the drum assembly is wet with fluid. If this is the case follow the procedures for replacement or reconditioning of the wheel cylinder in the proper repair manual.

Calipers: Problems with calipers which require service or replacement fall in two areas: (1) leakage around piston seal, (2) piston seizing in their bores.

If either problem exists the caliper will have to be disassembled and repaired according to the procedures outlined in the repair manual.

Rotors and drums: These components should be measured using the proper instrument to determine whether or not they are worn past their allowable limits or whether they can be resurfaced and reused. Before attempting to resurface a rotor or drum you should be checked out on the brake lathe operation by your instructor.

CAUTION: Either denatured alcohol or brake fluid should be used to clean brake components. Care must be taken not to allow these solutions to get into your eyes. Also, the use of air pressure to blow clean backing plates and other parts should be done sparingly.

A final check of the brake system components should include: Lines, checking hoses, fittings, couplings and joints for leaks. They should be repaired or replaced as necessary.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	02	3

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. When should you service wheel cylinders?
 - a. only when they leak fluid
 - b. only when they have frozen pistons
 - c. during every brake relining job
 - d. only when you service the master cylinder
2. Which of the following should be used to wash hydraulic brake parts?
 - a. denatured alcohol
 - b. gasoline
 - c. kerosene
 - d. diesel fluid
3. What is the best way to tell if the breather and compensating parts of the master cylinder are clean?
 - a. by putting a small piece of wire through them
 - b. by holding a light at the compression chamber and looking through the reservoir
 - c. filling up the reservoir and seeing if fluid runs out of the hole
 - d. none of the above
4. Service or replacement of the master cylinder must always include:
 - a. a brake relining job.
 - b. replacing a wheel cylinder.
 - c. adjusting pedal free play.
 - d. all of the above.
5. Which of the following are important safety steps during brake service?
 - a. the use of heavy duty brake fluid
 - b. avoid installing a front brake tube
 - c. secure all steel brake lines
 - d. all of the above

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	02	3

SELF-CHECK

RVTC

6. It is a good trade practice to rebuild disc brake calipers:
 - a. only if they are leaking brake fluid.
 - b. each time the brake pads are replaced.
 - c. each time the front wheel bearings are replaced.
 - d. all of the above.
7. The caliper is to disc brakes as the wheel cylinder is to:
 - a. the brake plate.
 - b. the master cylinder.
 - c. the drum type brake.
 - d. none of the above.
8. What is the best way to clean up a cylinder bore during a caliper overhaul?
 - a. sanding it with emery cloth
 - b. honing it with light abrasive stone
 - c. washing it with gasoline
 - d. rubbing it with engine oil
9. What is the trade practice for servicing the combination valve on disc brakes?
 - a. replace it with a rebuilt one if it is faulty
 - b. rebuild it with new parts if it is faulty
 - c. renew it if it is faulty
 - d. all of the above

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. CGJ.
IN	9043	E	02	3

SELF-CHECK

RVTC

Answer Key

1. c
2. a
3. b
4. c
5. d
6. d
7. c
8. b
9. c

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	02	3

ENABLING OBJECTIVE NO. 4
RVTC

Reassemble drum brakes and hardware.

LEARNING STEPS

1. View Resource No. 1 to identify the procedure for reassembling drum brakes.
2. Read Resource No. 2 to practice reassembling drum brakes.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 5.

RESOURCES

1. Bergwall Filmstrip/tape: Part 3, No. 404.
2. Instruction Sheet enclosed, Reassembling Drum Brakes
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	E	02	4

INSTRUCTION SHEET

RVTC

Reassembling Drum BrakesPAGE 1 OF 1

1. Before reassembling the drum brake components the master cylinder and wheel cylinders should be repositioned and secured if they were serviced, replaced or reconditioned. The master cylinder should be bled according to the instructions outlined in the proper repair manual.

NOTE: The following instructions are general. Detailed instructions should be obtained from the repair manual.

2. On the rear brakes, the parking brake lever should be connected to the secondary shoe. The secondary shoe is put into position with parking brake cable attached, retainer and springs put in place. Caution should be taken not to get fluid or grease on the shoe lining or drums.
3. The primary shoe is positioned and it's retainer and springs locked into place.
4. The self-adjuster screws, lever and springs are connected between the shoes.
5. The remaining hardware is attached to the shoes in the reverse order to which they were disassembled.
6. The front brakes are reassembled just as the rear except for the parking brakes.
7. When the brakes are completely reassembled a primary adjustment must be made. This adjustment can be made by using a brake set gauge or by using a conventional brake adjusting tool. The preliminary adjustment will provide the required clearance. Therefore, there is no possibility of continuous contact with the drum.
8. After the wheels are in place, a final adjustment is made and the following procedure is completed:
 - (1) tighten the adjuster until the wheel will not rotate.
 - (2) the adjuster is then loosened until only a slight brake shoe drag is felt.
9. After all brake shoe adjustments have been made, the access hole covers must be inserted.
10. Bleed the system according to the procedure outlined in the repair manual.
11. Road test the vehicle. Stop, back up using backward and forward gears and firm pedal pressure.

NOTE: Readjustment may be necessary.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	02	4

SELF-CHECK

RVTC

Directions

Evaluate your work by answering the items below.

All items should receive a "YES" response.

- | | <u>YES</u> | <u>NO</u> |
|--|------------|-----------|
| 1. Were safety glasses worn?..... | _____ | _____ |
| 2. Was repair procedure used?..... | _____ | _____ |
| 3. Were secondary shoes assembled?..... | _____ | _____ |
| 4. Were primary shoes assembled?..... | _____ | _____ |
| 5. Were self-adjuster screws, levers, and spring connected?..... | _____ | _____ |
| 6. Was correct preliminary adjustment made?..... | _____ | _____ |
| 7. Was access hole cover closed?..... | _____ | _____ |
| 8. Was parking brake adjusted?..... | _____ | _____ |
| 9. Was system bled?..... | _____ | _____ |

If you received a "NO" response for any item, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	02	4

ENABLING OBJECTIVE NO. 5

RVTC

Reassemble disc brakes and hardware.

LEARNING STEPS

1. View Resource No. 1 to identify the procedure for reassembling disc brakes and hardware.
2. Practice reassembling disc brakes using Resource No. 2.
3. Evaluate your work by completing the Self-Check.
4. When you think you can perform this task, take the Performance Test.

RESOURCES

1. a. Bergwall Filmstrip/tape: Part 5, No. 404.
b. Instruction Sheet enclosed, Reassembling Disc Brakes
2. 1978 Chevy test vehicle
3. Self-Check enclosed.
4. Performance Test for task E-02.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	E	02	5

INSTRUCTION SHEET

RVTC

PAGE 1 OF 1Reassembling Disc Brakes

The reassembly of the disc brake pads is a simple procedure but the repair manual should still be used.

1. Care should be taken not to allow grease or brake fluid on the pad stopping surface while reassembling.
2. The pads can either be reassembled while the caliper is disconnected following the disassembly procedures and reversing it or by placing the caliper in place over the rotor and pushing the caliper piston inward.
3. Bleed the system according to the procedure outlined in the repair manual.
4. There is not a preliminary adjustment to the pads themselves, but the wheel bearings should be tightened and then rechecked before the vehicle is road tested.

CAUTION: Spin the wheel to see if it binds or scrapes before it is driven.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	02	5

SELF-CHECK**RVTC**Directions

Evaluate your work by answering the items below.

All items should receive a "YES" response.

- | | <u>YES</u> | <u>NO</u> |
|---|------------|-----------|
| 1. Were safety glasses worn?..... | _____ | _____ |
| 2. Was caliper free of fluid or grease before the shoes
were replaced?..... | _____ | _____ |
| 3. Was the rotor free of fluid or grease before the
caliper was replaced?..... | _____ | _____ |
| 4. Were pins, retainers or clips attached?..... | _____ | _____ |
| 5. Were wheel bearings adjusted?..... | _____ | _____ |
| 6. Was wheel checked for binding or scraping?..... | _____ | _____ |
| 7. Was system bled?..... | _____ | _____ |

If you received a "NO" response for any item, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	02	5

PERFORMANCE TEST FOR TASK NO. E-02

RVTC

IN-9043-E-02

TASK:

Recondition Brake System

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will recondition brake system. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Were safety glasses worn?		
2.	Was repair manual used?		
3.	Was the vehicle secured on the lift?		
4.	Were brakes disassembled according to outlined procedure?		
5.	Were components laid out?		
6.	Were serviceable parts detected?		
7.	Were brakes and hardware cleaned and serviced?		
8.	Was cleaning solution selected as outlined?		
9.	Was cleaning solution selected to clean brake hardware?		
10.	Were all hoses, lines and connections checked for leaks?		
11.	Were brakes reassembled according to outlined procedure?		
12.	Were preliminary adjustments made?		
13.	Were wheel bearing adjustments made?		
14.	Was the bleeding process used as outlined?		
15.	Were correct tools used?		
16.	Were drums or rotors measured before and after the lathe was used?		
☐ ATTAINED Score _____ ☐ NOT ATTAINED		EVALUATOR'S SIGNATURE _____	
DEPT.	PROG.	DUTY	TASK
IN	9043	E	02
Page 1 of 1			

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VO-TECH CENTER

7700 State Road 544 N
Winter Haven, Florida 33880

IN-9043-D-07

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Perform Minor Tune-up

DUTY:

Repairing Minor Engine Problems and Tune-up

PURPOSE :

The internal combustion engine was designed to do a variety of different jobs to serve the needs of today's motorists. The level of proficiency that these engines obtain is directly proportionate to their state of tune. An engine out of tune will not realize its full power potential nor will it achieve the proper fuel economy so necessary in today's mode of travel.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	D	07	D-06

REVISED :

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

GIVEN: an engine and access to tools,

YOU WILL: perform minor tune-up.

HOW WELL: You must successfully complete the Written Test.
Your performance will be assessed by your instructor using the Performance Test on page 19.

NOTE:

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Identify reasons for tune-up.
2. Repair tune-up problems.
3. Make final adjustments.

DEPT.	PROG.	DUTY	TASK
IN	9043	D	07

ENABLING OBJECTIVE NO. 1

³
RVTC

Identify reasons for tune-up.

LEARNING STEPS

1. Read and view Resource No. 1 to identify the reasons for performing a tune-up.
2. Practice identifying the reasons for a tune-up, using Resource No. 2.
3. Evaluate your work by completing the Self-Check.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. a. Text: Chilton's Auto Repair Manual, "Unit Repair Section -- Engine Troubleshooting", General Diagnosis.
b. Hoffman slide/tape unit: 2.6.A.
2. Instruction Sheet enclosed, Procedure Sheet
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	D	07	1

INSTRUCTION SHEET

RVTC

PAGE 1 OF 2

Procedure Sheet

QUESTION TO ASK TO GET THE STORY RIGHT

1. What is the nature of the problem?
2. When does the problem occur? (Under what circumstances)
3. Is there a noise present during the problem?
4. Does the problem go and come or is it constant?
5. How many miles are there on the engine?
6. How many miles are there on the engine since the last tune-up?
7. What repairs were made during the last tune-up?
8. How many miles per gallon does the vehicle deliver?
9. What type or types of fuel does the vehicle use?
10. How many miles on an average is the vehicle driven on a monthly basis?
11. View Module No. 2.6.A.
12. Acquire necessary tools and equipment.
13. Warm up the engine until normal operating temperature is reached, then stop the engine.
14. Remove the air cleaner and any other components necessary to enable access to the spark plugs.
15. Remove all spark plugs and keep them in the order in which they were removed.
16. Turn the ignition switch to "On" and pull the coil wire from the distributor center tower and ground the coil wire.
17. Attach the remote starter switch.
18. Insert gauge or select proper adapter and screw adapter finger tight into the spark plug hole.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	D	07	1

INSTRUCTION SHEET

5
RVTC

PAGE 2 OF 2

19. Connect the loose end of the adapter to the compression test gauge.
20. With the carburetor throttle held open, crank the engine six times per cylinder tested.
21. Make note of the gauge reading.
22. Release pressure from gauge and disconnect the tester.
23. Repeat procedure for all cylinders.
24. Compare test results to specifications.
25. If necessary, squirt about a tablespoon of engine oil on top of the piston before performing a wet compression test.
26. Turn off the engine and remove the jumper wire and remote starter switch.
27. Reconnect all disconnected items.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	D	07	1

SELF-CHECK

RVTC

Directions

Evaluate your work by answering the items below.

All items should receive a "YES" response.

	YES	NO
1. Did the student get the story right?.....	_____	_____
2. Was the engine warmed up before starting the compression test?.....	_____	_____
3. Were the spark plugs kept in the order in which they were removed?.....	_____	_____
4. Were the compression readings recorded for the correct cylinder?.....	_____	_____
5. Was the compression test performed correctly?.....	_____	_____
6. Was the wet test performed correctly?.....	_____	_____
7. Were safety glasses worn?.....	_____	_____

If you received a "NO" response for any item, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	D	07	1

ENABLING OBJECTIVE NO. 2
RVTC

Repair tune-up problems.

LEARNING STEPS

1. View Resource No. 1 to identify the procedure for repairing tune-up problems.
2. Using Resource No. 2, practice repairing tune-up problems. Record all findings on Resource No. 2b. See instructor for live work.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 3.

RESOURCES

1.
 - a. Hoffman slide/tape units: 6.3.A., 6.3.B, 6.4.A., 6.4.C and 6.4.E.
 - b. Bergwall flimstrip/tape: parts 1 and 2, No. 402.

NOTE: These resources deal with conventional ignition. If you are working with electronic ignition point and dwell setting can be eliminated.
2.
 - a. Shop engine
 - b. Engine Tune-up Worksheet
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	D	07	2

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. One main reason a tune-up job is done:
 - a. is to prevent carbon build-up.
 - b. is to increase oil pressure.
 - c. is to provide preventive maintenance.
 - d. all of the above.
2. Whenever possible, what is the first step in doing a tune-up job?
 - a. a dry compression test
 - b. a wet compression test
 - c. replace the points
 - d. obtain information regarding existing problems of the engine
3. During a tune-up job, why does a mechanic examine spark plugs after removal?
 - a. to see if they are of correct heat range
 - b. to see if they can be used again
 - c. to see if there is oil entering the combustion chamber
 - d. all of the above.
4. The correct position for the throttle valve during a compression test, is:
 - a. closed.
 - b. wide open.
 - c. half open.
 - d. doesn't really matter.
5. Which one of the following would most likely cause a spark plug to become fouled with heavy, dull black carbon deposits?
 - a. carburetor choke valve stuck in a semi-closed position
 - b. leaking cylinder head gasket
 - c. engine needs a valve job
 - d. all of the above
6. What would cause the electrodes of a spark plug to prematurely erode away?
 - a. over-heating due to cooling system blockage
 - b. oil fouling
 - c. underheating of the cooling system
 - d. metal of the spark plug too soft

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	D	07	2

SELF-CHECK

RVTC

7. Which of the following is the "Right" way for tightening a spark plug?
 - a. with a $\frac{1}{2}$ " drive ratchet
 - b. with a torque wrench
 - c. with a breaker bar
 - d. with a box wrench
8. A set of ignition points should be replaced when they:
 - a. are blueish in color or pitted.
 - b. are light gray.
 - c. have no metal transfer.
 - d. are badly out of adjustment.
9. Which of the following is a reason for ignition points to be grounded out?
 - a. a loose primary wire to the (+) positive side of the coil
 - b. a loose primary wire to the (-) negative side of the coil
 - c. the terminal end of the condenser touching the base of the distributor
 - d. the center coil wire touching ground
10. Why is it necessary to lubricate the cam lobes of the upper cam assembly during ignition point replacement?
 - a. points will make better contact
 - b. to prolong the life of the rubbing block
 - c. prevent point bounce
 - d. helps the points to close faster
11. A dwell setting is an adjustment of:
 - a. the ignition points.
 - b. the ignition timing.
 - c. the charging circuit.
 - d. none of the above.
12. What is the main reason a mechanic "reads" faulty parts removed from the engine during tune-up work?
 - a. so they can be reused
 - b. so necessary changes can be made
 - c. so the owner may see them
 - d. so the employer may see them

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. CBJ.
IN	9043	D	07	2

SELF-CHECK

RVTC

Answer Key

1. c
2. d
3. d
4. b
5. a
6. a
7. b
8. a
9. c
10. b
11. a
12. b

All of your answers should agree with the answers in the Answer Key.
 If you missed any, go back and repeat one or more of the Learning
 Steps for this Enabling Objective.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	D	07	3

ENABLING OBJECTIVE NO. 3

RVTC

Make final adjustments.

LEARNING STEPS

1. View Resource No. 1 to identify the procedure for making final adjustments.
2. Using Resource No. 2 practice making final adjustments on a tune-up.
3. When you think you can attain this task, take the Written Test.
4. When you successfully complete the Written Test, take the Performance Test.

RESOURCES

1. a. Bergwall flimstrip/tape: part 3, No. 402.
b. Hoffman slide/tape units: 6.3.C and 5.5.A.
2. Instruction Sheet enclosed, Procedure Sheet
3. Written Test for task D-07.
4. Performance Test for task D-07.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	D	07	3

INSTRUCTION SHEET

RVTC

Procedure Sheet

PAGE 1 OF 1

NOTE: There are three adjustments that should be made before a tune-up is completed. 1. Dwell setting. 2. Ignition timing
3. Idle speed setting

SETTING THE DWELL

1. Attach the dwell meter to the engine to be tested.
2. Idle the engine.
3. The dwell can be altered by changing the point gap. If the dwell angle is too large then the point gap is too close and vice versa.
4. Run the engine up to around 1500 rpms. The dwell should not vary more than three degrees. If more than three degrees variation exists, then a faulty distributor is indicated.

IGNITION TIMING

1. To set the timing you need a timing light, proper distributor wrench, a test light, tachometer, a tune-up specification sheet and a piece of white marking chalk.
2. Look up the proper specification from the chart and all other information concerning timing for the specific make, model and year of vehicle being timed.

CAUTION: Be sure you have done everything suggested in the specifications to time the particular engine. Timing readings will vary if improperly prepared.

3. Loosen the distributor clamp just enough to allow the distributor to turn with a little resistance.
4. Attach the timing light as directed by the manufacturer.
5. Clean off the scale and vibration damper index marker.
6. If possible mark the specified line with chalk.
7. Attach the tachometer and start the engine. Direct the light beam on the timing marks.
8. Turn the distributor as required to bring the line on the damper and the mark on the scale together.
9. Tighten the distributor and recheck the timing. If not correct repeat the timing procedure.
10. CAUTION: Point gap or dwell must be set before timing as changing the gap will change the timing.

SETTING THE IDLE SPEED

1. The idle speed should be set after both the dwell and timing has been set.
2. Follow the manufacturer's suggested method for setting the idle found in the proper repair manual.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	D	07	3

WRITTEN TEST FOR TASK NO. D-07

RVTC

IN-9043-D-07

TASK:

Perform Minor Tune-up

DirectionsPAGE 1 OF 5

The purpose of this test is to determine if you fully understand how to perform minor tune-ups. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Multiple Choice. On the separate Answer Sheet, put the letter of the correct answer in the blank to the left of the number of the question.

DO NOT MARK ON THIS TEST!

Multiple Choice questions

1. A sign of engine oil on the tip of a spark plug indicates the following problem(s):
 - a. poor oil pressure.
 - b. good oil pressure.
 - c. a clogged return hole in the cylinder head.
 - d. a rich air-fuel mixture at the carburetor.
2. The correct position for the throttle valve during a compression test, is:
 - a. closed.
 - b. wide open.
 - c. half open.
 - d. doesn't really matter.
3. Normal compression pressure variations in multi-cylinder engines should be approximately:
 - a. 50 lbs. of each other.
 - b. 40 lbs. of each other.
 - c. 35 lbs. of each other.
 - d. 25 lbs. of each other.

DEPT.	PROG.	DUTY	TASK
IN	9043	D	07

WRITTEN TEST FOR TASK NO. D-07

RVTC

IN-9043-D-07

TASK:

Perform Minor Tune-up

PAGE 2 OF 5

4. When taking compression readings what is the main purpose of the "wet test"?
 - a. to lubricate the piston rings
 - b. to determine the compression ratio of the engine
 - c. to check the condition of the valve guides
 - d. to help determine the main reason for compression loss
5. When two adjacent cylinders register very low during a compression test, the most likely cause would be:
 - a. a blown head gasket between two cylinders.
 - b. a bad valve.
 - c. engine needs a ring job.
 - d. compression gauge is broken.
6. Which one of the following would most likely cause a spark plug to become fouled with heavy, dull black carbon deposits?
 - a. carburetor choke valve stuck in a semi-closed position
 - b. leaking cylinder head gasket
 - c. engine needs a valve job
 - d. all of the above
7. What would cause the electrodes of a spark plug to prematurely erode away?
 - a. over-heating due to cooling system blockage
 - b. oil fouling
 - c. underheating of the cooling system
 - d. metal of the spark plug too soft
8. Which of the following is the "Right" way for tightening a spark plug?
 - a. with a $\frac{1}{2}$ " drive ratchet
 - b. with a torque wrench
 - c. with a breaker bar
 - d. with a box wrench

DEPT.	PROG.	DUTY	TASK
IN	9043	D	07

WRITTEN TEST FOR TASK NO. D-07

RVTC

IN-9043-D-07

TASK:

Perform Minor Tune-up

PAGE 3 OF 5

9. Why is it recommended not to submerge a distributor in cleaning solvent while washing it?
- you will short out the electrical parts
 - the metal parts of the distributor will deteriorate
 - it is a waste of time
 - lubrication on the main shaft will be diluted
10. Premature point failure could be caused by:
- bad high tension wires.
 - worn spark plugs.
 - a faulty condenser.
 - none of the above.
11. What is the correct position of the upper cam assembly of the distributor when adjusting points with feeler gauge?
- when the rubbing block of the points reaches the highest points of the cam assembly
 - it doesn't matter what position it is in
 - somewhere between the lowest and highest point of the cam assembly
 - where the rubbing block of the points reaches the lowest point of the cam assembly
12. Why is it necessary to lubricate the cam lobes of the upper cam assembly during ignition point replacement?
- points will make better contact
 - to prolong the life of the rubbing block
 - prevent point bounce
 - helps the points to close faster
13. A dwell setting is an adjustment of:
- the ignition points.
 - the ignition timing.
 - the charging circuit.
 - none of the above.

DEPT.	PROG.	DUTY	TASK
IN	9043	D	07

WRITTEN TEST FOR TASK NO. D-07

RVTC

IN-9043-D-07

TASK:

Perform Minor Tune-up

PAGE 4 OF 5

14. What is possibly wrong when a distributor dwell angle error is excessive at high rpm engine speed?
- the engine needs a valve job
 - the distributor main shaft and bushings are worn
 - the points are set too close
 - the points are set too far apart
15. Which of the following is the best way to assure correct alignment of the rotor in relation to the upper cam assembly?
- mark it before removal
 - use of trial and error method
 - an arrow on the rotor, indicating front
 - by the use of a round and square peg on the rotor
16. How would improper rotor installation affect the running of the engine?
- would cause the engine to be out of ignition timing
 - would cause late valve timing
 - would cause early valve timing
 - would cause none of the above
17. How will a high tension wire terminal that is badly corroded affect the ignition system?
- it will cause resistance to the flow of current
 - it will perform satisfactorily, if it is not open
 - it is not a serious problem, it can wait until all the wires go bad
 - none of the above
18. High tension wires should be replaced when they show signs of:
- dryness.
 - brittleness.
 - being oil soaked.
 - all of the above.

DEPT.	PROG.	DUTY	TASK
IN	9043	D	07

WRITTEN TEST FOR TASK NO. D-07

RVTC

IN-9043-D-07

TASK:

Perform Minor Tune-up

PAGE 5 OF 5

19. What is the correct procedure for replacing high tension wires?
- remove all of them at one time
 - remove two at once, be sure they are adjacent to each other
 - there is no correct procedure
 - replace them one at a time
20. The following should be done before charging a battery:
- check the specific gravity.
 - fill it with water.
 - remove the negative terminal.
 - all of the above.
21. Which of the following is included during a good tune-up job?
- tighten all ignition primary connections
 - check the condition of all V-belts
 - replace all worn water hoses
 - all of the above

DEPT.	PROG.	DUTY	TASK
IN	9043	D	07

WRITTEN TEST FOR TASK NO. D-07

RVTC

TASK:

Perform Minor Tune-up

ANSWER KEY

PAGE 1 OF 1

Multiple Choice questions

<u>c</u> 1.	<u>a</u> 6.	<u>a</u> 11.	<u>a</u> 16.	<u>d</u> 21.
<u>b</u> 2.	<u>a</u> 7.	<u>b</u> 12.	<u>a</u> 17.	<u> </u> 22.
<u>d</u> 3.	<u>b</u> 8.	<u>a</u> 13.	<u>d</u> 18.	<u> </u> 23.
<u>d</u> 4.	<u>d</u> 9.	<u>b</u> 14.	<u>d</u> 19.	<u> </u> 24.
<u>a</u> 5.	<u>c</u> 10.	<u>d</u> 15.	<u>d</u> 20.	<u> </u> 25.

True-False questions

T F 1.	T F 6.	T F 11.	T F 16.	T F 21.
T F 2.	T F 7.	T F 12.	T F 17.	T F 22.
T F 3.	T F 8.	T F 13.	T F 18.	T F 23.
T F 4.	T F 9.	T F 14.	T F 19.	T F 24.
T F 5.	T F 10.	T F 15.	T F 20.	T F 25.

Matching questions

<u> </u> 1.	<u> </u> 6.	<u> </u> 11.	<u> </u> 16.	<u> </u> 21.
<u> </u> 2.	<u> </u> 7.	<u> </u> 12.	<u> </u> 17.	<u> </u> 22.
<u> </u> 3.	<u> </u> 8.	<u> </u> 13.	<u> </u> 18.	<u> </u> 23.
<u> </u> 4.	<u> </u> 9.	<u> </u> 14.	<u> </u> 19.	<u> </u> 24.
<u> </u> 5.	<u> </u> 10.	<u> </u> 15.	<u> </u> 20.	<u> </u> 25.

DEPT.	PROG.	DUTY	TASK
IN	9043	D	07

PERFORMANCE TEST FOR TASK NO. D-07

RVTC

IN-9043-D-07

TASK:

Perform Minor Tune-up

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will perform a minor tune-up. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Were safety glasses worn?.....		
2.	Did the student get the story right?		
3.	Was a compression test performed?		
4.	Was a wet test performed?		
5.	Were the spark plugs read?		
6.	Were the points inspected?		
7.	Was the upper cam assembly inspected?		
8.	Were the high tension wires inspected?		
9.	Was the distributor cap inspected?		
10.	Was the rotor inspected?		
11.	Were the spark plugs gapped correctly?		
12.	Were ignition points replaced?		
13.	Was point gap set?		
14.	Was dwell set with the dwell meter?		
15.	Was the ignition timing set?		
16.	Was the idle speed set according to the manufacturer's specifications?		
17.	Were worn parts saved for customer inspection?		
18.	Was the specification manual used?		
☐ ATTAINED Score _____ ☐ NOT ATTAINED		EVALUATOR'S SIGNATURE _____	
DEPT.	PROG.	DUTY	TASK
IN	9043	D	07
ATTEMPT		Page <u>1</u> of <u>1</u>	

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IN-9043-D-01

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Identify Fuel System Components

DUTY:

Repairing Minor Engine Problem and Tune-ups

PURPOSE :

The fuel system carries fuel from the fuel tank to the engine cylinder and aids in the efficiency of the system. Identification of these components will aid you in diagnosing and repairing the system.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	D	01	

REVISED				

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

- GIVEN:** 305 cu. in. Chevy engine on display in the shop,
- YOU WILL:** identify fuel system components (conventional and with pollution control units).
- HOW WELL:** Your performance will be assessed by your instructor using the Performance Test on page 9.

NOTE:

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Identify conventional fuel system components.
2. Identify fuel system components with pollution control units.

DEPT.	PROG.	DUTY	TASK
IN	9043	D	01

ENABLING OBJECTIVE NO. 1

RVTC

Identify conventional fuel system components.

LEARNING STEPS

1. Read Resource No. 1 to identify conventional fuel system components.
2. Using Resource No. 2, practice identifying fuel system components.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. Text: Crouse Automotive Mechanics, Chapter 18, pages 151 - 160.
2. Shop engine, 305 cu. in. Chevy
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	D	01	1

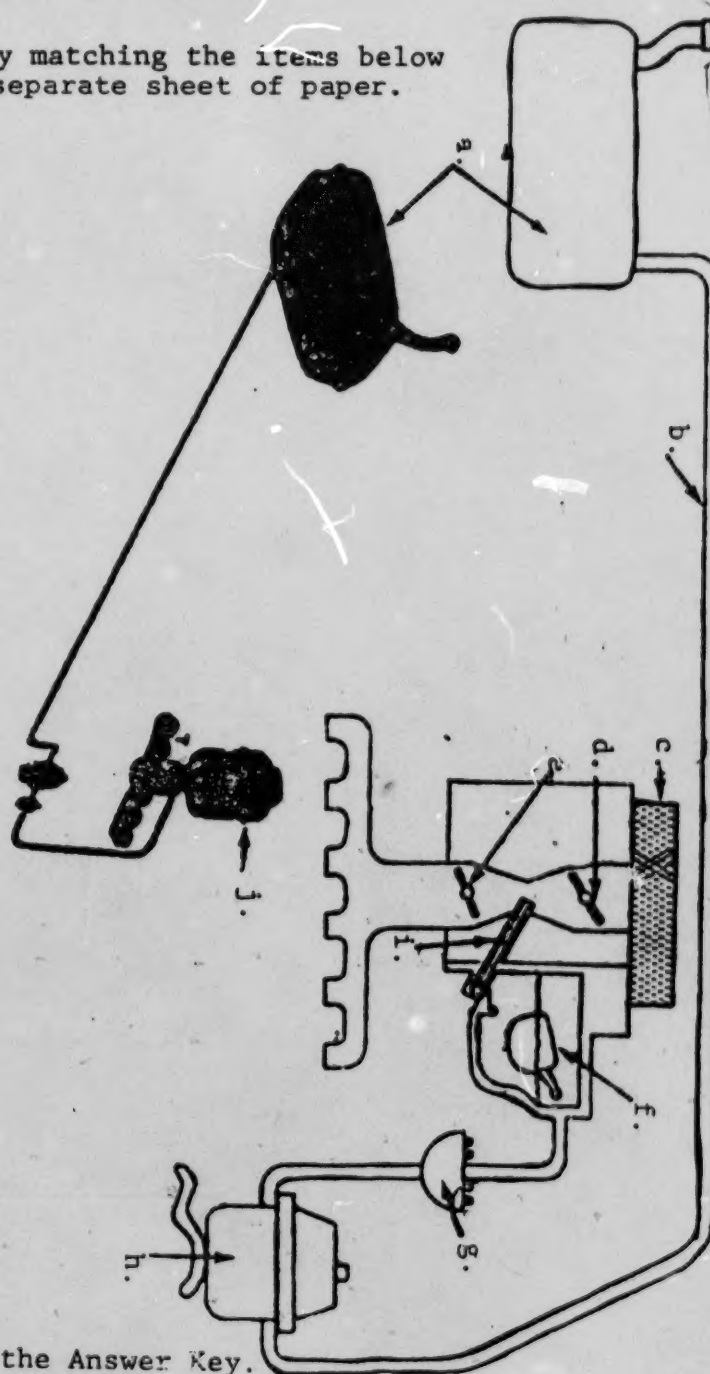
SELF-CHECK

RVTC

Directions

Evaluate your knowledge by matching the items below with the diagram. Use a separate sheet of paper.

1. Fuel tank
2. Fuel line
3. Air line
4. Choke
5. Throttle
6. Float
7. Fuel filter
8. Fuel pump
9. Jet
10. Carburetor



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	D	01	1

SELF-CHECK**RVTC**Answer Key

1. a
2. b
3. c
4. d
5. e
6. f
7. g
8. h
9. i
10. j

All of your answers should agree with the answers in the Answer Key.
If you missed any, go back and repeat one or more of the Learning
Steps for this Enabling Objective.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	D	01	1

ENABLING OBJECTIVE NO. 2

RVTC

Identify fuel system components with pollution control units.

LEARNING STEPS

1. Read Resource No. 1 to identify fuel system components with pollution control units.
2. Evaluate your knowledge by completing the Self-Check.
3. When you think you can perform this task, take the Performance Test.

RESOURCES

1. Text: Engine Tune-up Service, unit 5, pages 1 - 4.
2. Self-Check enclosed.
3. Performance Test for task D-01.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	D	01	2

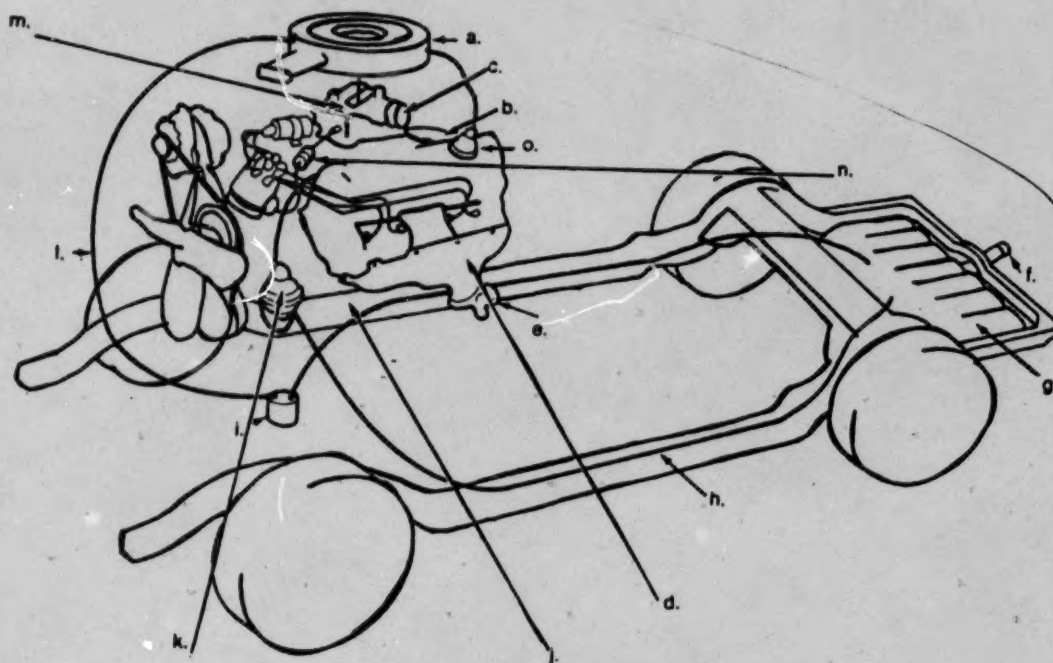
SELF-CHECK

7
RVTC

Directions

Evaluate your knowledge by matching the items below with the diagram. Use a separate sheet of paper.

- | | |
|--------------------------------|------------------------------|
| 1. air cleaner | 9. fuel tank |
| 2. carburetor | 10. vacuum pressure fuel cap |
| 3. choke | 11. fuel line |
| 4. intake manifold | 12. charcoal canister |
| 5. crankcase | 13. canister vent line |
| 6. exhaust manifold | 14. fuel pump |
| 7. manifold heat control valve | 15. PCV valve |
| 8. fuel filter | 16. ballast resistor |



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	D	01	2

SELF-CHECK**RVTC**Answer Key

1. a
2. m
3. c
4. b
5. j
6. d
7. e
8. n
9. g
10. f
11. h
12. i
13. l
14. k
15. o

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	D	01	2

PERFORMANCE TEST FOR TASK NO. D-01

RVTC

IN-9043-D-01

TASK:

Identify Fuel System Components

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will identify fuel system components. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Was the air cleaner identified?		
2.	Was the carburetor identified?		
3.	Was the choke identified?		
4.	Was the intake manifold identified?		
5.	Was the crankcase identified?		
6.	Was the exhaust manifold identified?		
7.	Was the manifold heat control valve identified?		
8.	Was the fuel filter identified?		
9.	Was the fuel tank identified?		
10.	Was the vacuum pressure cap identified?		
11.	Was the fuel line identified?		
12.	Was the charcoal canister identified?		
13.	Was the canister vent line identified?		
14.	Was the fuel pump identified?		
15.	Was the PCV valve identified?		
☐ ATTAINED ☐ NOT ATTAINED			
Score _____		EVALUATOR'S SIGNATURE _____	
DEPT.	PROG.	DUTY	TASK
IN	9043	D	01
		Page 1 of 1	

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IN-9043-D-04

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Rebuild Common Carburetor

DUTY:

Repairing Minor Engine Problems and Tune-ups

PURPOSE :

The carburetor is a complex fuel system component which mixes fuel and air to a precise ratio. Since this ratio must change to accommodate different operating conditions, the carburetor has different circuits that allow a smooth and automatic fuel-air ratio change. Due to wear and contamination, periodic service, repair and overhaul is necessary to restore carburetor efficiency.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	D	04	D-03

REVISED

STUDENT PERFORMANCE OBJECTIVES:

RVTC

TERMINAL PERFORMANCE OBJECTIVE:

GIVEN: a carburetor and access to tools and equipment,

YOU WILL: rebuild a common carburetor.

HOW WELL: Your performance will be assessed by your instructor using the Performance Test on page 7.

NOTE:

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Disassemble carburetor.
2. Clean carburetor.
3. Reassemble carburetor.
4. Make final adjustments.

DEPT	PROG.	DUTY	TASK
IN	9043	D	04

ENABLING OBJECTIVE NO. 1

3

RVTC

Disassemble carburetor.

LEARNING STEPS

1. Read Resource No. 1 to identify the procedure for disassembling a carburetor.
2. Complete Resource No. 2, as a Self-Check. Have your instructor check your work.
3. Using Resource No. 3, practice disassembling a carburetor.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. Text: Engine Tune-up Service, Student Guide, Unit 5, pages 125 - 136.
2. Text: Engine Tune-up Service, Review Exercise Book 21, Unit 5, pages 99 - 106.
3. Text: Engine Tune-up Service, Student Guide, Work Activities, Unit 5, page 137.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	D	04	1

ENABLING OBJECTIVE NO. 2

RVTC

Clean carburetor.

LEARNING STEPS

1. Read Resource No. 1 to identify the procedure for cleaning a carburetor.
2. Complete Resource No. 2 as a Self-Check.
3. Using Resource No. 3 practice cleaning a carburetor.
4. Go on to Enabling Objective No. 3.

RESOURCES

1. Text: Engine Tune-up Service, Student Guide, Unit 5, pages 137 - 138.
2. Text: Engine Tune-up Service, Review Exercise Book 22, Unit 5, pages 107 - 108.
3. Text: Engine Tune-up Service, Student Guide, Work Activities, Unit 5, page 139.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	D	04	2

ENABLING OBJECTIVE NO. 3

⁵
RVTC

Reassemble carburetor.

LEARNING STEPS

1. Read Resource No. 1 to identify the procedure for reassembling a carburetor.
2. Complete Resource No. 2, as a Self-Check.
3. Using Resource No. 3, practice reassembling a carburetor.
4. Go on to Enabling Objective No 4.

RESOURCES

1. Text: Engine Tune-up Service, Student Guide, Unit 5, pages 139 - 149.
2. Text: Engine Tune-up Service, Review Exercise Book 23, Unit 5, pages 109 - 121.
3. Text: Engine Tune-up Service, Student Guide, Work Activities, Unit 5, page 150.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	D	04	3

ENABLING OBJECTIVE NO. 4
RVTC

Make final adjustments.

LEARNING STEPS

1. Read Resource No. 1 to identify the procedures for making final carburetor adjustments.
2. Complete Resource No. 2, as a Self-Check. Have your instructor check your work.
3. Using Resource No. 3, practice making final carburetor adjustments.
4. When you think you can perform this task, take the Performance Test.

RESOURCES

1. Text: Engine Tune-up Service, Student Guide, Unit 5, pages 73 - 82.
2. Text: Engine Tune-up Service, Review Exercise Book 15, Unit 5, pages 59 - 62.
3. Text: Engine Tune-up Service, Student Guide, Work Activities, page 82.
4. Performance Test for task D-04.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	D	04	4

PERFORMANCE TEST FOR TASK NO. D-04

RVTC

TASK:

Rebuild Common Carburetor

IN-9043-D-04

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will rebuild common carburetor. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED: For successful attainment <u>ALL</u> items must receive a "YES" response.	YES	NO
1.	Were safety glasses worn?.....		
2.	Was carburetor completely disassembled?.....		
3.	Was carburetor cleaned?.....		
4.	Was carburetor inspected for worn or damaged parts?.....		
5.	Were throttle body, float bowl and air horn assembled?.....		
6.	Was float adjusted properly?.....		
7.	Was air horn assembly installed?.....		
8.	Was carburetor reassembled?.....		
9.	Were necessary adjustments made according to manufacturer's specifications?.....		
10.	Was tachometer hooked up properly?.....		
11.	Was idle speed adjusted to manufacturer's specifications?.....		
12.	Was the idle mixture screw adjusted to manufacturer's specifications?.....		
13.	Were all safety precautions followed?.....		

☐ ATTAINED
☐ NOT ATTAINED

Score _____

DEPT.	PROG.	DUTY	TASK	ATTEMPT
IN	9043	D	04	

EVALUATOR'S SIGNATURE _____
 Page 1 of 1

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IN-9043-A-02

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Identify Hand Tools and Describe Their Use

DUTY:

Identifying Orientation Procedures

PURPOSE :

Tools are designed to last a lifetime with proper use and care. A tool can be damaged if not used correctly. A tool may also cause injury to the mechanic if the tool is not used in the correct manner for the proper job. This Learning Guide will help you to recognize hand tools and understand their use.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	A	02	

REVISED

STUDENT PERFORMANCE OBJECTIVES:

RVTC

TERMINAL PERFORMANCE OBJECTIVE:

GIVEN:

YOU WILL: identify and describe the use of each.

HOW WELL: You must successfully complete the Written Test.

NOTE:

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Identify hand tools.
2. Describe the use of each.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	02

ENABLING OBJECTIVE NO. 1

RVTC

Identify hand tools.

LEARNING STEPS

1. View Resource No. 1a or read Resource No. 1b to identify hand tools. Go through your tool box and find each tool.
2. Read Resource No. 2 to identify cutting tools.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. a. Hoffman slide/tape unit: 5.2.3 A.
- b. Text: Crouse Automotive Mechanic, pages 28-32.
- c. Tool box
2. Text: Crouse Automotive Mechanics, pages 34-36.
3. Self Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	A	02	1

SELF-CHECK

RVTC

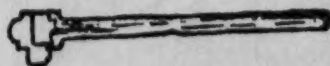
Directions

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

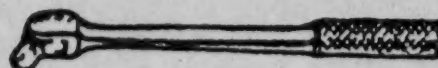
1. The box end wrench should be used rather than the open end wrench when possible.
2. Tight screws should be removed by striking the screw handle with a hammer.
3. Pulling wrenches to your body rather than pushing is the correct method.
4. Tools must be modified to do many jobs.
5. Channel lock pliers are the correct tool to remove carburetor fuel line.

Identify the following tools:

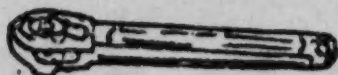
1.



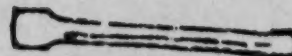
2.



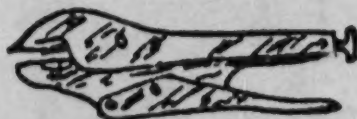
3.



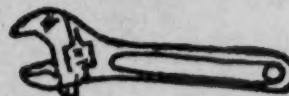
4.



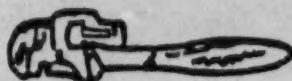
5.



6.



7.



8.



9.



10.

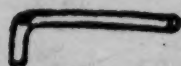


DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	02	1

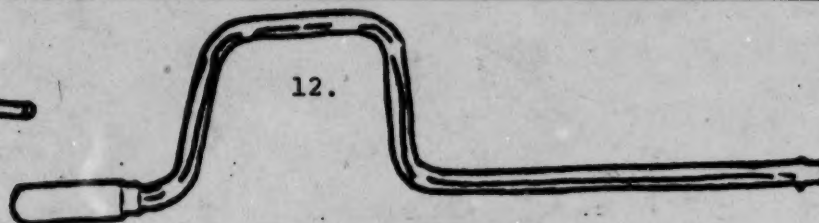
SELF-CHECK

RVTC

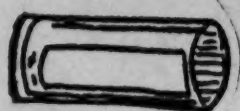
11.



12.



13.



14.



15.



16.



17.



18.



19.



20.



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IND	9043	A	02	1

SELF-CHECK

RVTC

Answer Key

1. T
2. F
3. T
4. F
5. F

Identification

- | | |
|------------------------------|---------------------------|
| 1. Sliding T handle | 11. Set screw wrench |
| 2. Flex handle | 12. Speed handle |
| 3. Ratchet handle | 13. Deep double hexagon |
| 4. Extension bar | 14. Flexsocket |
| 5. Vise grip wrench | 15. Double hexagon socket |
| 6. Adjustable hand wrench | 16. Universal joint |
| 7. Pipe wrench | 17. Needle nose pliers |
| 8. Combination wrench | 18. Diagonal pliers |
| 9. Open end wrench | 19. Battery pliers |
| 10. Double offset box wrench | 20. Channel lock pliers |

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IND	9043	A	02	1

ENABLING OBJECTIVE NO. 2

RVTC

Describe the use of hand tools.

LEARNING STEPS

1. Read and complete Resource No. 1.
2. When you think you can attain this task, take the Written Test.

RESOURCES

1. Text: Introduction to Auto Mechanics, Unit 1, pages 17-55
Exercise 1-7, "Use of Hand Tools"
2. Written Test for task A-02.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	A	02	2

WRITTEN TEST FOR TASK NO. A-02

RVTC

TASK:

Identify Hand Tools and Describe Their Use

Directions

PAGE 1 OF 2

The purpose of this test is to determine if you fully understand how to identify hand tools and describe their use. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Multiple Choice. On the separate Answer Sheet, put the letter of the correct answer in the blank to the left of the number of the question.

DO NOT MARK ON THIS TEST!

Multiple Choice questions

1. The item in Figure 1 is a pair of:

- a. channel lock pliers.
- b. needle nose pliers.
- c. diagonal pliers.
- d. battery pliers.

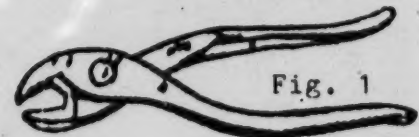


Fig. 1

2. The item in Figure 2 is a/an:

- a. deep socket.
- b. off-set socket.
- c. six point socket.
- d. universal socket.



Fig. 2

3. The item in Figure 3 is a/an:

- a. open end wrench.
- b. combination wrench.
- c. box end wrench.
- d. off-set wrench.

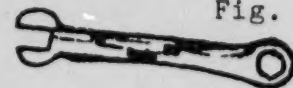


Fig. 3

4. The item in Figure 4 is a:

- a. flex handle.
- b. sliding T handle.
- c. ratchet handle.
- d. speed handle.



Fig. 4

DEPT.	PROG.	DUTY	TASK
IN	9043	A	02

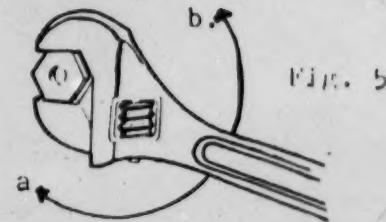
WRITTEN TEST FOR TASK NO. A-02
RVTC
TASK:

Identify Hand Tools and Describe Their Use

IN-9043-A-02

 PAGE 2 OF 2

5. The correct tool to use on flare tubing is a/an:
 - a. combination wrench.
 - b. split box wrench.
 - c. pipe wrench.
 - d. open end wrench.
6. Figure 5 shows a hand adjustable wrench, indicate the direction this tool would be turned in the diagram when used correctly.
 - a. downwards.
 - b. upwards.
7. The correct method of cutting with a hacksaw is to use:
 - a. quick strokes in both direction.
 - b. quick strokes in the pushing direction only.
 - c. even strokes in both directions.
 - d. even strokes in the pushing direction only.
8. Use safety glasses when:
 - a. cutting with a chisel.
 - b. hammering.
 - c. cutting with a hacksaw.
 - d. using all the above.
9. A good rule to follow is to:
 - a. never heat any tool.
 - b. never modify any tool for a job.
 - c. never put a tool away before cleaning it.
 - d. practice all of the above.
10. If you damage or break a tool or loose a tool you should:
 - a. borrow one from your neighbor's box.
 - b. borrow one from the tool room.
 - c. try to repair or replace it.
 - d. tell your instructor.



DEPT.	PROG.	DUTY	TASK
IN	9043	A	02

WRITTEN TEST FOR TASK NO. A-02

RVTC

TASK:

Identify Hand Tools and Describe Their Use

ANSWER KEY

PAGE 1 OF 1Multiple Choice questions

- | | | | | |
|-------------|--------------|-----------------|-----------------|-----------------|
| <u>d</u> 1. | <u>a</u> 6. | <u> </u> 11. | <u> </u> 16. | <u> </u> 21. |
| <u>d</u> 2. | <u>d</u> 7. | <u> </u> 12. | <u> </u> 17. | <u> </u> 22. |
| <u>b</u> 3. | <u>d</u> 8. | <u> </u> 13. | <u> </u> 18. | <u> </u> 23. |
| <u>a</u> 4. | <u>d</u> 9. | <u> </u> 14. | <u> </u> 19. | <u> </u> 24. |
| <u>b</u> 5. | <u>d</u> 10. | <u> </u> 15. | <u> </u> 20. | <u> </u> 25. |

True-False questions

- | | | | | |
|--------|---------|---------|---------|---------|
| T F 1. | T F 6. | T F 11. | T F 16. | T F 21. |
| T F 2. | T F 7. | T F 12. | T F 17. | T F 22. |
| T F 3. | T F 8. | T F 13. | T F 18. | T F 23. |
| T F 4. | T F 9. | T F 14. | T F 19. | T F 24. |
| T F 5. | T F 10. | T F 15. | T F 20. | T F 25. |

Matching questions

- | | | | | |
|----------------|-----------------|-----------------|-----------------|-----------------|
| <u> </u> 1. | <u> </u> 6. | <u> </u> 11. | <u> </u> 16. | <u> </u> 21. |
| <u> </u> 2. | <u> </u> 7. | <u> </u> 12. | <u> </u> 17. | <u> </u> 22. |
| <u> </u> 3. | <u> </u> 8. | <u> </u> 13. | <u> </u> 18. | <u> </u> 23. |
| <u> </u> 4. | <u> </u> 9. | <u> </u> 14. | <u> </u> 19. | <u> </u> 24. |
| <u> </u> 5. | <u> </u> 10. | <u> </u> 15. | <u> </u> 20. | <u> </u> 25. |

DEPT.	PROG.	DUTY	TASK
IND	9043	A	02

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IN-9043-D-01

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Identify Fuel System Components

DUTY:

Repairing Minor Engine Problem and Tune-ups

PURPOSE :

The fuel system carries fuel from the fuel tank to the engine cylinder and aids in the efficiency of the system. Identification of these components will aid you in diagnosing and repairing the system.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	D	01	

REVISED

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

GIVEN: 305 cu. in. Chevy engine on display in the shop,

YOU WILL: identify fuel system components (conventional and with pollution control units).

HOW WELL: Your performance will be assessed by your instructor using the Performance Test on page 9.

NOTE:

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Identify conventional fuel system components.
2. Identify fuel system components with pollution control units.

DEPT.	PROG.	DUTY	TASK
IN	9043	D	01

3
ENABLING OBJECTIVE NO. 1

RVTC

Identify conventional fuel system components.

LEARNING STEPS

1. Read Resource No. 1 to identify conventional fuel system components.
2. Using Resource No. 2, practice identifying fuel system components.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. Text: Crouse Automotive Mechanics, Chapter 18, pages 151 - 160.
2. Shop engine, 305 cu. in. Chevy
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	D	01	1

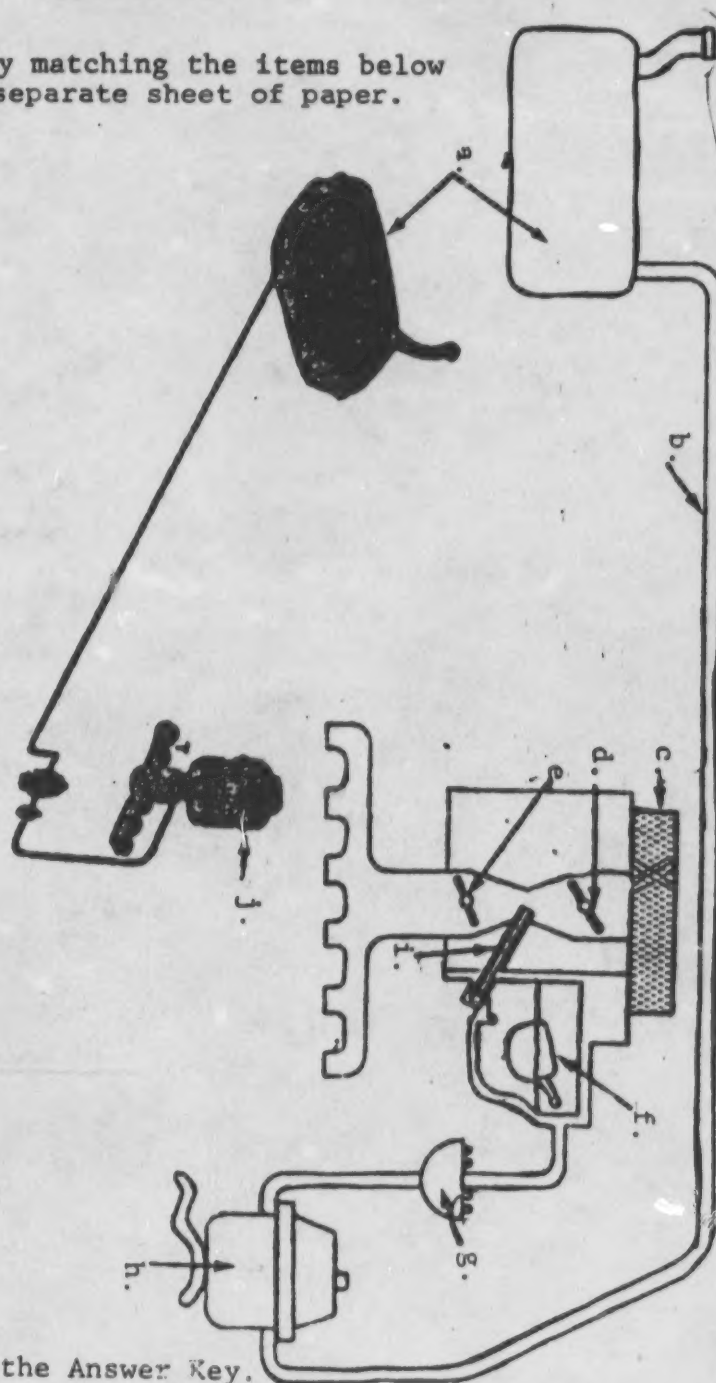
SELF-CHECK

RVTC

Directions

Evaluate your knowledge by matching the items below with the diagram. Use a separate sheet of paper.

1. Fuel tank
2. Fuel line
3. Air line
4. Choke
5. Throttle
6. Float
7. Fuel filter
8. Fuel pump
9. Jet
10. Carburetor



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	D	01	1

SELF-CHECK**RVTC**Answer Key

1. a
2. b
3. c
4. d
5. e
6. f
7. g
8. h
9. i
10. j

All of your answers should agree with the answers in the Answer Key.
If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	D	01	1

ENABLING OBJECTIVE NO. 2
RVTC

Identify fuel system components with pollution control units.

LEARNING STEPS

1. Read Resource No. 1 to identify fuel system components with pollution control units.
2. Evaluate your knowledge by completing the Self-Check.
3. When you think you can perform this task, take the Performance Test.

RESOURCES

1. Text: Engine Tune-up Service, unit 5, pages 1 - 4.
2. Self-Check enclosed.
3. Performance Test for task D-01.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	D	01	2.

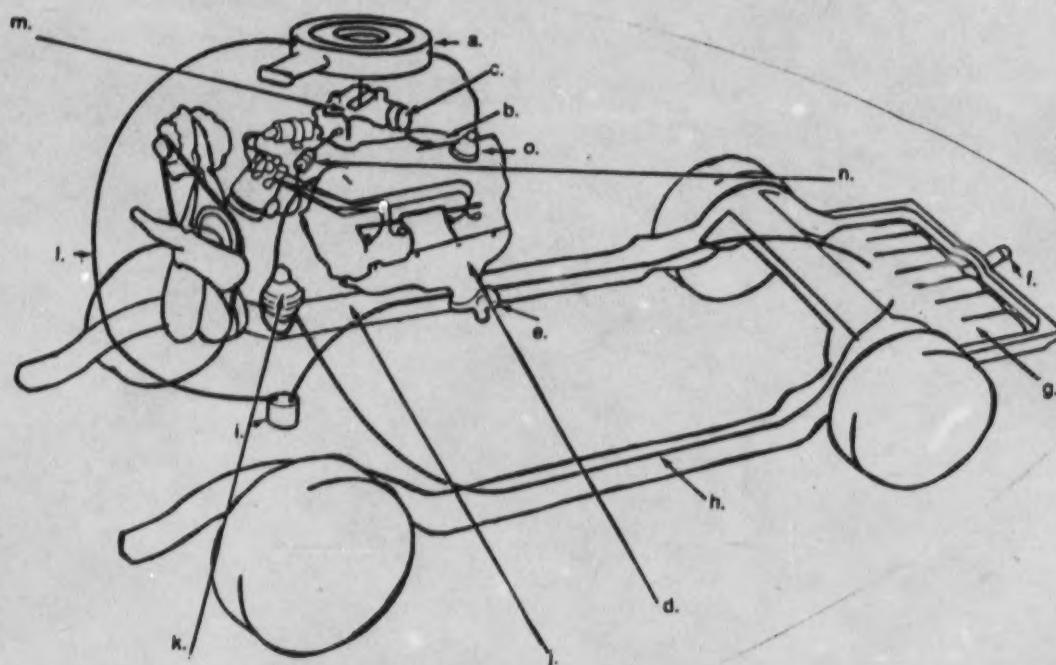
SELF-CHECK

RVTC

Directions

Evaluate your knowledge by matching the items below with the diagram. Use a separate sheet of paper.

- | | |
|--------------------------------|------------------------------|
| 1. air cleaner | 9. fuel tank |
| 2. carburetor | 10. vacuum pressure fuel cap |
| 3. choke | 11. fuel line |
| 4. intake manifold | 12. charcoal canister |
| 5. crankcase | 13. canister vent line |
| 6. exhaust manifold | 14. fuel pump |
| 7. manifold heat control valve | 15. PCV valve |
| 8. fuel filter | 16. ballast resistor |



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	D	01	2

SELF-CHECK**RVTC**Answer Key

1. a
2. m
3. c
4. b
5. j
6. d
7. e
8. n
9. g
10. f
11. h
12. l
13. l
14. k
15. o

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	D	01	2

PERFORMANCE TEST FOR TASK NO. D-01

RVTC

IN-9043-D-01

TASK:

Identify Fuel System Components

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will identify fuel system components. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Was the air cleaner identified?		
2.	Was the carburetor identified?		
3.	Was the choke identified?		
4.	Was the intake manifold identified?		
5.	Was the crankcase identified?		
6.	Was the exhaust manifold identified?		
7.	Was the manifold heat control valve identified?		
8.	Was the fuel filter identified?		
9.	Was the fuel tank identified?		
10.	Was the vacuum pressure cap identified?		
11.	Was the fuel line identified?		
12.	Was the charcoal canister identified?		
13.	Was the canister vent line identified?		
14.	Was the fuel pump identified?		
15.	Was the PCV valve identified?		
☐ ATTAINED ☐ NOT ATTAINED			
Score _____		EVALUATOR'S SIGNATURE _____	
DEPT.	PROG.	DUTY	TASK
IN	9043	D	01
Page 1 of 1			

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VO-TECH CENTER

7700 State Road 544 N
Winter Haven, Florida 33880

IN-9043-A-03

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Identify Safety Procedures in the Shop

DUTY:

Identifying Orientation Procedures

PURPOSE :

Automotive repair shops can be a safe or dangerous place to work, depending on the condition of equipment and the safety procedures which are followed when it is used. This Learning Guide is designed to alert you to dangers involved when working with automotive tools, equipment and vehicles in the auto shop.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	A	03	

REVISED

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

GIVEN: material and resources in this Learning Guide,

YOU WILL: identify safety procedures in the auto shop.

HOW WELL: You must successfully complete the Written Test.

ENABLING OBJECTIVES:

1. Identify safety equipment and areas of danger in the auto shop.
2. Identify safety procedures in the shop.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

ENABLING OBJECTIVE NO. 1
RVTC

Identify safety equipment and areas of danger in the auto shop.

LEARNING STEPS

1. Read Resource No. 1a and participate in the discussion to identify possible hazards in the shop (Resource No. 1b).
2. Complete Resource No. 2 to identify shop equipment and the areas of danger.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. a. Text: Crouse Automotive Mechanics, pages 19 - 22.
b. Group discussion on shop safety and hazards.
2. Shop tour by Instructor
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	A	03	1

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. The auto shop has how many fire extinguishers?
 - a. 1
 - b. 2
 - c. 3
 - d. 4
2. Maximum speed limit while moving cars to and from the auto shop is:
 - a. 5 m.p.h.
 - b. 10 m.p.h.
 - c. 15 m.p.h.
 - d. 20 m.p.h.
3. Where is gasoline stored in the auto shop?
 - a. metal cans
 - b. yellow storage cabinets
 - c. gas tanks of shop vehicles
 - d. gasoline is not stored in the auto shop
4. Before students can work in the auto shop they must:
 - a. complete the Learning Guide on shop safety.
 - b. wear safety glasses.
 - c. wear leather shoes.
 - d. complete all of the above.
5. The First Aid Kit is located in what part of the auto shop?
 - a. tool room
 - b. classroom
 - c. material storage room
 - d. office

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	A	03	1

SELF-CHECK

RVTC

Answer Key

1. b
2. b
3. b
4. d
5. d

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	03	1

ENABLING OBJECTIVE NO. 2

RVTC

Identify safety procedures in the shop.

LEARNING STEPS

1. View Resource No. 1 to identify the safety procedures in the shop.
2. Read Resource No. 2 to review shop safety rules.
3. Attend Resource No. 3 before going on to the next step.
4. When you think you can attain this task, take the Written Test.

RESOURCES

1. Bergwall Filmstrip/tape: No. 411.
2. Text: Crouse Automotive Mechanics; page 20, paragraphs 3-5.
3. Oral interview with Instructor
4. Written Test for task A-03.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	A	03	2

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

IN-9043-A-03

DirectionsPAGE 1 OF 18

The purpose of this test is to determine if you fully understand safety procedures in the shop. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Multiple Choice. On the separate Answer Sheet, put the letter of the correct answer in the blank to the left of the number of the question.

DO NOT MARK ON THIS TEST!

Multiple Choice questions

1. Which of the following is (are) responsible for causing accidents while doing auto repair work?
 - a. lack of instructions
 - b. careless work habits
 - c. improper uniform
 - d. all of the above.
2. To prevent an eye injury, safety glasses should be worn:
 - a. while working underneath the vehicle.
 - b. whenever automotive shopwork is being done.
 - c. when you are welding or cutting metal.
 - d. when the instructor is watching you work.
3. A student is raising a vehicle, the wheels on the floor jack are binding, which of the following could happen?
 - a. the height of the jack head will be extended beyond its normal height
 - b. the height of the jack head will be reduced below its normal height
 - c. the jack head will slip out of its jacking position
 - d. none of the above

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

PAGE 2 OF 18

IN-9043-A-03

4. Which of the following are good safety steps while jacking up a vehicle?
 - a. release the parking brake.
 - b. shift gear position to neutral position
 - c. chock a wheel front and rear with wood
 - d. all of the above
5. While lifting a vehicle with a floor jack, the jack head should be positioned in one of the following positions:
 - a. the engine oil pan.
 - b. the rear transmission mount.
 - c. under the front coil spring.
 - d. all of the above.
6. What should a new auto mechanics student do when he isn't sure of where to place the head of the floor jack when raising a vehicle?
 - a. ask another student
 - b. seek advice from his instructor
 - c. guess at a spot on the frame that you think will support the jack.
 - d. none of the above
7. Why is it wrong to work under a vehicle supported by a floor jack?
 - a. because floor jacks do not raise the vehicle high enough to work under.
 - b. because floor jacks were only designed to change tires
 - c. because of a sudden failure in the hydraulic controls of the jack could cause an accident
8. The main function of jack stands is to:
 - a. support the vehicle after it's jacked up.
 - b. jack up the final drive housing.
 - c. jack up the chassis.
 - d. keep the vehicle from rolling after it is jacked up.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

PAGE 3 OF 18

IN-9043-A-03

9. A replacement sheer pin is needed for use on a jack stand, what is the first consideration?
 - a. the shape of the handle
 - b. that it be of the same size and sheer strength of the original
 - c. that it be made of brass so it will not rust
 - d. that it be made of cast iron so it will not bend
10. When used in pairs, jack stands must always:
 - a. be raised at the same height.
 - b. be placed so that one is at least six inches higher than the rear.
 - c. be used so that the front of the vehicle will be higher than the rear.
 - d. none of the above.
11. Which of the following jacks should never be used to do auto repair work?
 - a. the floor jack
 - b. the air operated garage type bumper jack
 - c. the bumper jack supplied by the automobile factory with every new car
 - d. none of the above
12. The first step in the operation of the air type bumper jack is to:
 - a. select the proper spot on the bumper to be jacked.
 - b. apply air pressure lightly to the control valve.
 - c. apply full pressure to the control valve.
 - d. slide the adjustable plates to the most inward positions.
13. What is the main function of the mechanical racket on the air controlled bumper jack?
 - a. to permit the operator to work under the jack without the use of horses.
 - b. it helps raise the vehicle quicker
 - c. it functions as a safety device
 - d. all of the above

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03
RVTC
TASK:

Identify Safety Procedures in the Shop

 PAGE 4 OF 18

14. Which of the following is the most correct sequence for raising a vehicle on a drive-lift?
 - a. put shift selector in Park, chock one wheel, center car on lift
 - b. chock one wheel, center car on lift, put shift lever to park position
 - c. center car on lift, apply parking brake, shift lever to park position, chock one wheel
 - d. none of the above
15. Most lifts operate with:
 - a. oil under air pressure.
 - b. air under oil pressure.
 - c. air pressure alone.
 - b. oil pressure alone.
16. What prevents a "Drive-on" lift from falling in the event of a failure in the controls?
 - a. a mechanical safety device
 - b. a second set of air-oil pressure controls
 - c. a big sheer pin located at the top of the lifting piston
 - d. none of the above
17. Which of the following procedures should you follow when operating a hydraulic lift?
 - a. remove all objects from under the lift before lowering it
 - b. do not shake the vehicle once it is raised more than six inches from the ground
 - c. use a ladder to enter and exit the vehicle once it is raised and resting on the safety device
 - d. all of the above
18. The frame lift raises a vehicle at:
 - a. two points of the chassis.
 - b. four points of the chassis.
 - c. six points of the chassis.
 - d. eight points of the chassis.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

PAGE 5 OF 18

19. The first step in safe operation of the frame lift is to:
- drive the vehicle in straight.
 - shake the vehicle after raising it.
 - be sure the lifting arms are down and pointing into each other.
20. When raising a vehicle on a "frame" lift, the lifting chucks should contact:
- a strong part of the frame.
 - the center of the rear axle housing..
 - the other ends of the rear axle housing.
 - the lower ball joints.
21. On a vehicle equipped with uni-body construction where should the rear chucks be positioned?
- under the rear coil springs
 - under the rear leaf springs
 - under a spot on the body marked "lift"
 - none of the above
22. A beginning student of auto mechanics is not sure of where to place the lifting chucks on a vehicle equipped with uni-body construction, what should he do?
- ask his instructor
 - position them on the widest part of the frame
 - position them on the narrowest part of the frame
 - none of the above
23. Why does an operator of a frame lift raise a vehicle six inches off the ground then shake it from side to side?
- to center it on the lift.
 - to check to be sure the chucks are secure on the frame
 - to check the action of the shock absorbers
 - to test the action of the rear and front springs
24. You should never work under a vehicle unless the lift is:
- at least one-half the way up.
 - at least three-quarters of the way up.
 - fully raised.
 - fully raised and the safety catch in position.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

PAGE 6 OF 18

25. What is the final step before moving the vehicle out of the shop during the operation of a frame lift?
- shake the vehicle from side to side
 - lower the front chucks
 - position the lifting arms inward toward each other
 - lower the rear chucks
26. Which one of the following machines require the use of a face mask?
- the 1/4" drill
 - the drill press
 - the power driven wire wheel
 - the drum lathe
27. The recommended way to avoid a possible hand injury when operating the power driven wire wheel is to press your work:
- at the top of the wire wheel.
 - as hard as you can into the wire wheel.
 - against the side of the wire wheel.
 - lightly mid-way into the front of the wire wheel.
28. Which of the following are trade-like practices while using a power driven wire wheel?
- rub the "backside" of a metal edge
 - use a vise grip pliers on small objects.
 - use leather gloves
 - all of the above
29. How much space is required between a grinding stone and the guard when using a pedestal grinder?
- none, the grinding wheel should be just touching the guard
 - a little smaller space than the object you are working with
 - twice the space of the object you are working with
 - none of the above
30. The trade-like procedure for using a power driven grinding wheel is to:
- always use one hand.
 - always hold small objects in your hand.
 - always use the top of the wheel.
 - none of the above.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

PAGE 7 OF 18

31. Good hand control is lessened when the operator of a pedestal grinder:
- crowds the work into the rotating wheel.
 - uses very light pressure when pushing the work against the rotating wheel.
 - uses moderate pressure when pushing the work against the rotating wheel.
 - none of these.
32. Grinding metal objects usually leaves:
- cracks on the opposite side of the metal.
 - holes on the opposite side of the metal.
 - burrs on the opposite side of the metal.
 - scratches on the opposite side of the metal.
33. Which color is used to indicate the stop position of a pedestal grinder on-off switch?
- green
 - red
 - yellow
 - black
34. What is the function of a valve refacing lathe?
- to restore a worn valve
 - to grind new shapes on metal objects
 - to clean carbon from engine parts
 - all of the above
35. How much pressure should be used when dressing the stone of a valve refacing lathe?
- very light pressure
 - ligh pressure
 - moderate pressure
 - heavy pressure

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

PAGE 8 OF 18

36. The purpose for the "stop" on the valve refacing machine is to:
- let the operator know when the valve face is finished during a grinding operation.
 - prevent the refacing stone from digging into the valve stem during a grinding operation.
 - it functions as an automatic stop, after the valve face is reground.
 - all of the above.
37. What could happen if a valve were to fall out of place during a grinding operation?
- personal injury to the operator
 - damage to the lathe
 - damage to the valve
 - all of the above
38. During the operation of a brake drum lathe, which of the following are a hazard to the operation?
- loose clothing
 - loose tie
 - long hair
 - all of the above
39. What is the last "safety precaution" taken before turning the machine on during a drum refacing job?
- be sure the damper band is on
 - measure the drum diameter
 - tighten the spindle nut
 - none of the above
40. Which is the best way to check the effectiveness of your drum-cutting job?
- rub your finger on the machine surface while the lathe is running
 - stop the lathe, make a visual inspection, recut if necessary
 - stop the lathe, remove the drum, recut if necessary
 - all of the above

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

PAGE 9 OF 18

IN-9043-A-03

41. The function of the brake-shoe grinder is to:
- put a finish cut on the brake drum.
 - bond brake lining to brake shoes.
 - rivet brake lining to brake shoes.
 - grind new brake lining to match the diameter of a reground drum.
42. What is the correct way to fasten a lifting chain to an engine?
- fasten the end of the lifting chain flat on the engine
 - use extra long capscrews, be sure the end of the chain is not flat on the engine
 - use long capscrews, screw them in part-way so they will swivel
 - none of the above
43. Which of the following can be one of the most dangerous power tools in automobile shop work?
- pedestal grinder
 - the valve refacer
 - the hand electric drill
 - none of the above
44. The trade-like way to use an electric hand drill is to:
- use two hands.
 - balance your body, both feet on the ground.
 - not use a drill while standing in water.
 - all of the above.
45. What is the function of the third prong on some electrical adapters?
- it supports the adapter while it's in place
 - it's a ground wire, it increases line voltage
 - it's a ground wire, it protects the operator from an electrical shock
 - it functions as a three way electrical outlet

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

PAGE 10 OF 18

46. Electric adapters with a third pigtail wire are:
- most effective if they are grounded to the center of an electrical receptacle.
 - really not necessary and should be cut off.
 - none of the above.
47. Automotive electrical extensions should always be of the:
- single wire type.
 - double wire type.
 - three wire type.
 - four wire type.
48. What is the required length of an electrical extension in an automotive repair shop?
- just long enough to reach the vehicle
 - long enough to reach the working area with enough slack to reach the ground
 - twenty-five feet
 - thirty-five feet
49. Which of the following is the proper way to pass a floor jack across a drop light extension wire?
- if the weight of the vehicle is not on the jack, run right over the wire
 - run over the wire with the jack one wheel at a time
 - lift the wire up and pass the jack under the wire
 - none of the above
50. The first thing to do if a fire is caused by the vehicles electrical system is:
- call the Police Department.
 - call the Fire Department.
 - fight the fire.
 - disconnect the battery ground cable.
51. Pouring water on a gasoline fire will cause it:
- to spread.
 - to go out eventually.
 - to smother.
 - none of the above.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

PAGE 11 OF 18

52. How many feet away from the fire should you be when you start using the fire extinguisher on a liquid fire?
- one foot
 - two to three feet
 - six to ten feet
 - twenty feet
53. Which of the following is the correct way to use a CO₂ fire extinguisher?
- direct the discharge one foot over the flame using an up and down motion
 - direct the discharge just under the flame using a side to side motion
 - direct the discharge right into the flame
 - all of the above
54. When fighting a fire, if possible always keep:
- your back toward the wind.
 - your face toward the wind.
 - your side toward the wind.
 - none of the above.
55. After a fire extinguisher is used it should be:
- recharged.
 - repainted.
 - recharged and returned to its proper location.
 - recharged and stored out of everyone's way.
56. Oily rags should be stored in a/an:
- open container.
 - extra thick cardboard container.
 - wire mesh type waste container..
 - none of the above.
57. Gasoline must always be stored in a:
- glass container.
 - plastic container.
 - metal container.
 - self-closing can.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

PAGE 12 OF 18

58. When cleaning an object with compressed air, you should:
- hold it close to your body while blowing air from the nozzle.
 - have someone hold the object close to their body while you blow air from the nozzle.
 - hold it at arms length downward to the ground before blowing air from the nozzle.
 - hold the object being cleaned at arms length toward the ceiling of the room.
59. What is the proper way to disconnect two air lines?
- shut-down the compressor motor first
 - shut off the main air valve at the compressor first
 - to uncouple them, holding each one firm in both hands
 - pinch each one before you uncouple them
60. The recommended air pressure for cleaning purposes is:
- 5 psi
 - 15 psi
 - 18 psi
 - 30 psi.
61. Why must a body grinder be held with both hands during operation?
- because it's heavy
 - because it rotates at a fast rate of speed
 - because the grinder head rotates in a clockwise direction
 - none of the above
62. Which of the following is (are) good safety practice when operating a body grinder?
- do not grind too close to a tear in the metal
 - be sure the on-off switch is in the "off" position before plugging the line cord into an electrical wall outlet
 - hold the grinder until it stops spinning after a grinding operation
 - all of the above
63. The safe way to place a creeper while working on a vehicle is:
- on the outside of the right front wheel.
 - on the outside of the left rear wheel.
 - under the vehicle.
 - none of the above.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

IN-9043-A-03

PAGE 13 OF 18

64. Creepers should be stored in an area of the automotive shop:
- where traffic is at a minimum.
 - where traffic is at a maximum.
 - near the front exit.
 - near the rear exit.
65. During automotive shop work, metal rings on your fingers:
- should be switched over to your right hand if you are left-handed.
 - should be switched over to your left hand if you are right-handed.
 - should be removed.
 - none of the above.
66. Students of automotive mechanics should never use a machine they are not familiar with until:
- they have reached the age of 17.
 - they have received operating instructions from their teacher.
 - they have read an instruction manual.
 - all of the above.
67. Which of the following jobs can be done with an oxyacetylene unit?
- heat metal objects
 - weld metal objects together
 - cut metal objects apart
 - all of the above
68. Welding goggles should be worn:
- only when welding metal together.
 - only when heating metal.
 - only when cutting metal apart.
 - whenever you are operating an oxyacetylene torch.
69. Oxyacetylene tanks should be moved from one area to another in the shop:
- with a welding cart.
 - lying down on an automotive creeper.
 - with a floor jack.
 - none of the above.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

PAGE 14 OF 18

IN-9043-A-03

70. What is the trade-like practice before installing a regulator onto an acetylene tank?
- clean the face of the dials
 - bleed the hoses
 - open the main valve part way for a second
 - open the main valve all the way for five minutes
71. It's recommended that the operating pressure of acetylene not be more than:
- 25 psi
 - 50 psi
 - 75 psi
 - none of the above.
72. Whenever possible which of the following should be avoided when operating an oxyacetylene unit?
- welding an object in a vertical position
 - welding cast iron materials together
 - welding in an area where grease and oil are used
 - none of the above
73. Leaks in an oxyacetylene unit should be checked:
- by passing a match over the area you suspect is leaking.
 - by passing soapy water over the area you suspect is leaking.
 - by holding your hand over the area you suspect is leaking.
 - none of the above.
74. Which of the following are unsafe practices while using an oxy-acetylene torch?
- point the tip of the torch at yourself
 - point the tip of the torch at the gauges
 - point the tip of the torch at the flammable objects around you
 - all of the above
75. The "safest" way to weld near the area of a gasoline tank is to:
- remove the tank.
 - protect it with a wooden shield.
 - protect it with a metal shield.
 - protect it with a cardboard shield.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

PAGE 15 OF 18

76. Using an oxyacetylene torch too close to a concrete floor will cause:
- the concrete to melt.
 - the concrete to explode.
 - the concrete to stick to the metal you are welding.
 - none of the above.
77. Which of the following is the last step in oxyacetylene torch operation?
- open the main valve on the tanks
 - adjust the gauges for maximum pressure
 - bleed the gauges and hoses
 - all of the above
78. Which of the following is the most hazardous during a drill press operation?
- using the wrong speed for drilling very heavy metal
 - forgetting to remove a chuck key after operating the drill
 - using a dull drill
 - using a high speed drill for drilling holes on a wood project
79. The safest way to hold a piece of metal while drilling it on a drill press is to:
- hold it against your body.
 - hold it with a pair of pliers.
 - clamp it down on the bed of the drill press.
 - none of the above.
80. What is the purpose of the large sliding clamp at the rear of the drill press bed?
- to clamp the work as it's being drilled
 - to lock the bed in position
 - to secure the drill press to the wall
 - none of the above
81. The function of the hydraulic press is to:
- test the operation of the hydraulic brake system.
 - raise the vehicle up when working on it.
 - pull apart or press together different components of a vehicle.
 - all of the above.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

PAGE 16 OF 18

IN-9043-A-03

82. Which of the following precautions must be taken before applying hydraulic pressure to a hydraulic press?
- the pins are in place on the vertical bars
 - the I beam is resting on both pins
 - the work being pressed is supported by steel bars across the I beam
 - all of the above
83. Applying pressure to the bed of the eye beam of a hydraulic press without the beam resting on the pins will:
- strain or break the lifting cables.
 - break the I beam.
 - break a hydraulic line.
 - none of the above.
84. What is the maximum amount of hydraulic pressure that should be applied to a hydraulic press?
- 10 ton
 - 15 ton
 - 25 ton
 - the amount that is recommended on the gauge of the press
85. The trade-like practice for protection against flying metal during some pressing operations is to:
- wear an apron.
 - wear two shirts.
 - position a shield of some sort between you and the press.
 - none of the above.
86. One of the first steps in battery charging is to:
- check the charging voltage of the vehicle.
 - fill it with acid.
 - fill it with water.
 - none of the above.
87. Which of the following should never be done during battery service?
- breathe toxic fumes from a charging battery
 - create a spark during a battery charge
 - rub your eyes when cleaning corrosive materials from cables
 - all of the above

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

IN-9043-A-03

PAGE 17 OF 18

88. What is the best way to carry a battery?
- with a battery carrier
 - with your hands supporting it underneath
 - with two pair of pliers
 - with a vise grip on a single post
89. Pointed objects or tools should never be carried:
- in a pants pockets.
 - in a tool box with other tools.
 - in a container with the point protected.
 - none of the above.
90. Hand tools unfit for use should be:
- repaired by the student.
 - thrown out.
 - reported to your instructor.
 - used with caution.
91. Spark plug sockets should never be used to tighten:
- a leaf type spring.
 - a cylinder head cap screw.
 - a wheel lug.
 - all of the above.
92. It's a good trade practice to keep your hands and tools clean:
- at the completion of every job.
 - at the end of the day.
 - at all times.
 - twice a day.
93. Oil spills on an automotive shop floor should be cleaned:
- at the end of the day.
 - immediately.
 - once a week.
 - twice a week.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

PAGE 18 OF 18

94. What is the "main" reason for the operator of a remote control garage door to stand by the control switch until the vehicle is in the shop?
- to avoid an accident
 - to let more than one car in the shop
 - to lower the door down a little bit at a time
 - none of the above
95. Why is it unsafe to drive into an automotive shop while the door is being raised?
- a misjudgment on the part of the driver may cause an accident
 - a mechanical failure on some part of the car could cause an accident
 - a failure in the remote controls of the automatic door opener may occur
 - any one of the above
96. All automotive repair shops must have:
- a place to wash cars.
 - a front-end alignment machine.
 - a means to relieve exhaust gases when running engines indoors.
 - none of the above.
97. When tuning an engine indoors it's a good trade practice not to start an engine unless the:
- engine is timed.
 - air cleaner is off the carburetor.
 - carburetor is adjusted.
 - exhaust pipe is connected to an exhaust system.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

WRITTEN TEST FOR TASK NO. A-03

RVTC

TASK:

Identify Safety Procedures in the Shop

PAGE 1 OF 1Answer Key

- | | | | | |
|-------|-------|-------|-------|-------|
| 1. d | 23. b | 44. d | 65. c | 87. d |
| 2. b | 24. d | 45. c | 66. b | 88. b |
| 3. c | 25. c | 46. a | 67. d | 89. a |
| 4. d | 26. c | 47. c | 68. d | 90. c |
| 5. c | 27. d | 48. b | 69. a | 91. d |
| 6. b | 28. d | 49. c | 70. c | 92. c |
| 7. c | 29. b | 50. d | 71. d | 93. b |
| 8. a | 30. d | 51. a | 72. c | 94. a |
| 9. b | 31. a | 52. c | 73. b | 95. d |
| 10. a | 32. c | 53. b | 74. d | 96. c |
| 11. c | 33. b | 54. a | 75. a | 97. d |
| 12. a | 34. a | 55. c | 76. b | |
| 13. c | 35. c | 56. d | 77. c | |
| 14. c | 36. b | 57. d | 78. b | |
| 15. a | 37. d | 58. c | 79. c | |
| 16. a | 38. d | 59. c | 80. b | |
| 17. d | 39. c | 60. d | 81. c | |
| 18. b | 40. b | 61. b | 82. d | |
| 19. c | 41. d | 62. d | 83. a | |
| 20. a | 42. a | 63. c | 84. d | |
| 21. c | 43. c | 64. a | 85. c | |
| 22. a | | | 86. c | |

DEPT.	PROG.	DUTY	TASK
IN	9043	A	03

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7700 State Road 544 N
Winter Haven, Florida 33880

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Diagnose and Repair Drive Lines

DUTY:

Perform Maintenance and Repair on Drive Train

PURPOSE :

This task is basic repair work and a common repair for the auto mechanic. A thorough understanding of the drive train is essential in diagnosing problems and repairing them.

Materials appearing on the Instruction Sheets in this guide were reprinted with permission from Ford, 3000 Schaefer Road, Dearborne, Michigan 48121.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	B	03	B-02

REVISED :

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:****GIVEN:** tools, and a customer's vehicle,**YOU WILL:** diagnose and repair a problem in a drive line.**HOW WELL:** Your performance will be assessed by your instructor using the Performance Test on page 19.**ENABLING OBJECTIVES:**

1. Describe the location and purpose of the drive line.
2. Identify the parts of a drive line.
3. Test the mechanical condition of a drive line.
4. Diagnose and repair a drive line.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	03

ENABLING OBJECTIVE NO. 1

RVTC

Describe the location and purpose of the drive line.

LEARNING STEPS

1. Read Resource No. 1 to identify the location and purpose of the drive line.
2. Read Resource No. 2 to identify the location of the drive line of the automobile.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. a. Text: Crouse Automotive Mechanic, page 496, Paragraph 51-1.
b. Instruction Sheet enclosed, Location and Operation of Drive Line.
2. Instruction Sheet enclosed, Location of Drive Line in Automobile
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	03	1

INSTRUCTION SHEET

RVTC

PAGE 1 OF 2Location and Operation of Drive Line

In order to understand the mechanics of a drive line we must define the terms used.

Horsepower is the amount of work being done and the rate at which it is being done. One horsepower is the equivalent of lifting 33,000 pounds one foot in one minute. The term means force at work. This means there must be results, because force without results is not work.

When the engine tries to start and can't, it is not putting out horsepower. Although, it is applying a twisting force to the drive line. This twisting force is called torque. If the drive line has 100 foot pounds of torque the twisting force would be equal to 100 pounds of pressure bearing on a lever arm one foot from the center of the drive line.

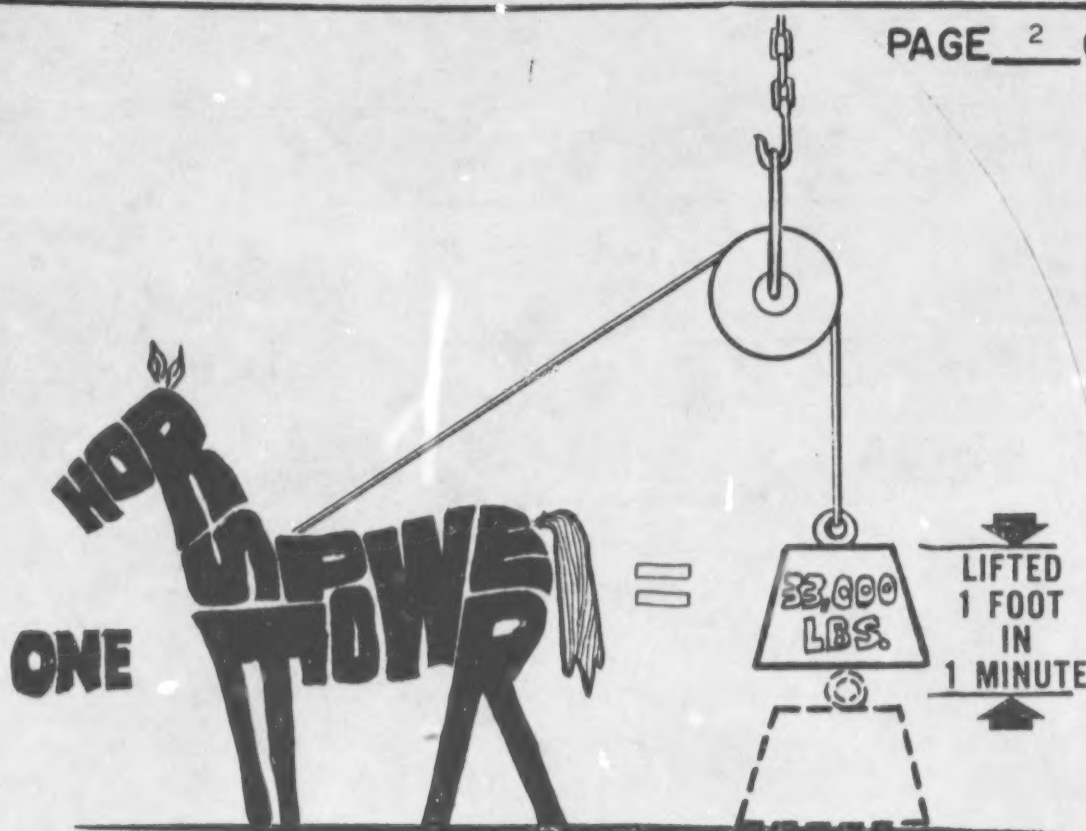
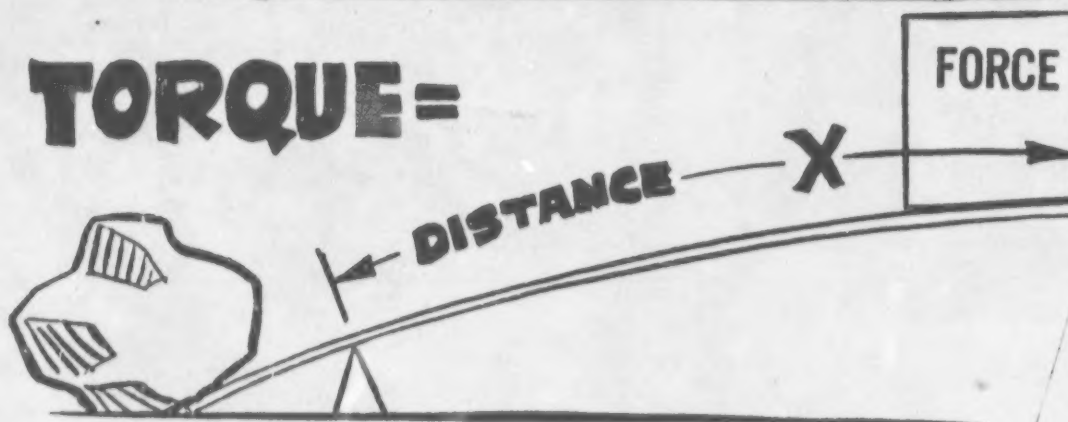
When the drive line starts to move as a result of torque, then power flow starts and work is being done. Horsepower is now being used and the rear wheels turn.

See the illustration on the following page.

DEPT	PROG	DUTY	TASK	EN OBJ.
IN	9043	B	03	1

INSTRUCTION SHEET

RVTC

PAGE 2 OF 2**TORQUE =****EXAMPLE:**

1 FOOT DISTANCE $\times$ 100 LBS FORCE =
100 FT-LBS OF TORQUE

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	03	1

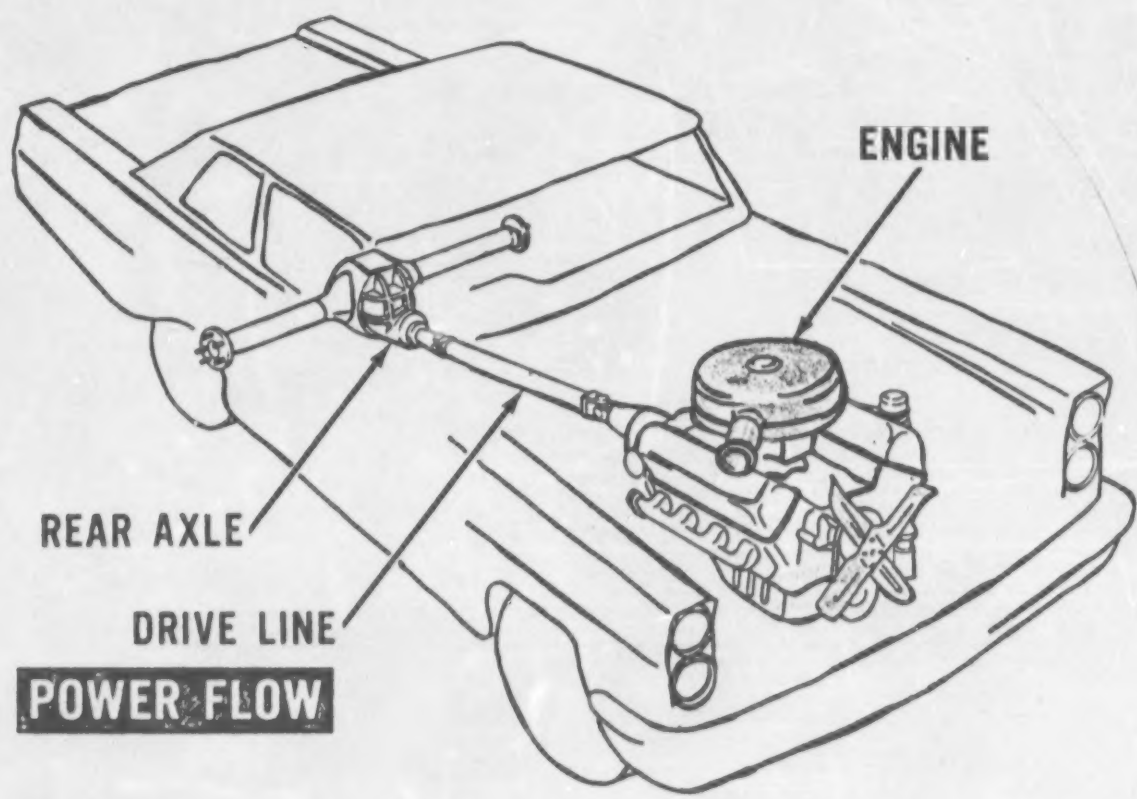
INSTRUCTION SHEET

RVTC

PAGE 1 OF 2

Location of Drive Line in Automobile

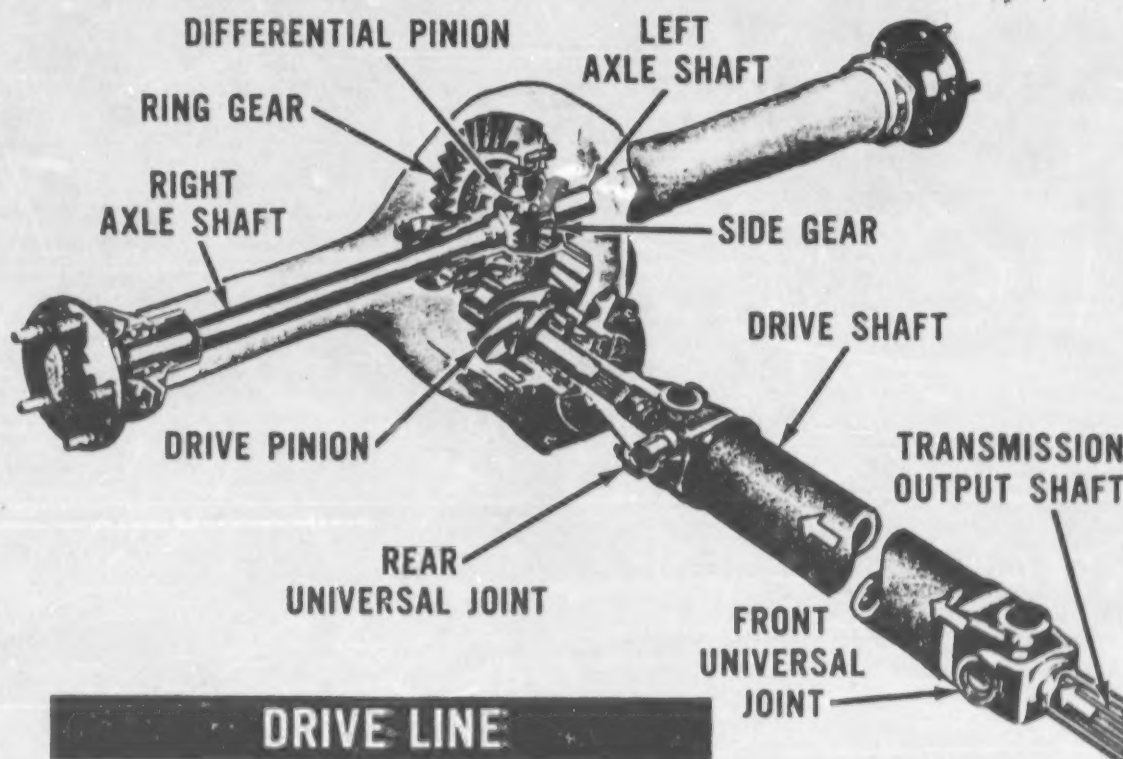
The engine transmits a twisting force (torque) to the transmission, which applies pressure to the drive line. The drive line transmits this torque to the wheels. When enough force is applied to make the wheels turn then the power flow is started. The power flow is generated at the engine and is transferred to the wheels by the drive line.



DEPT.	PROG	DUTY	TASK	EN OBJ.
IN	9043	B	03	1

INSTRUCTION SHEET

RVTC

PAGE 2 OF 2

DEPT	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	03	1

SELF-CHECK**RVTC**Directions

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. One horsepower is equal to the force applied to lift 33,000 pounds 1 foot in one minute.
2. One foot pound of torque is equal to the force applied to lift one pound in one minute.
3. The drive line of an automobile is the area visible to the driver of the vehicle.
4. The drive line transmits the engine power to the drive wheels of the vehicle.
5. If the drive line is not turning, then torque is not being applied.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	F	03	1

SELF-CHECK**RVTC**Answer Key

1. T
2. F
3. F
4. T
5. F

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	03	1

ENABLING OBJECTIVE NO. 2

RVTC

Identify the parts of a drive line.

LEARNING STEPS

1. Read Resource No. 1 to identify the parts of a drive line.
2. View Resource No. 2 to identify drive line parts.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 3.

RESOURCES

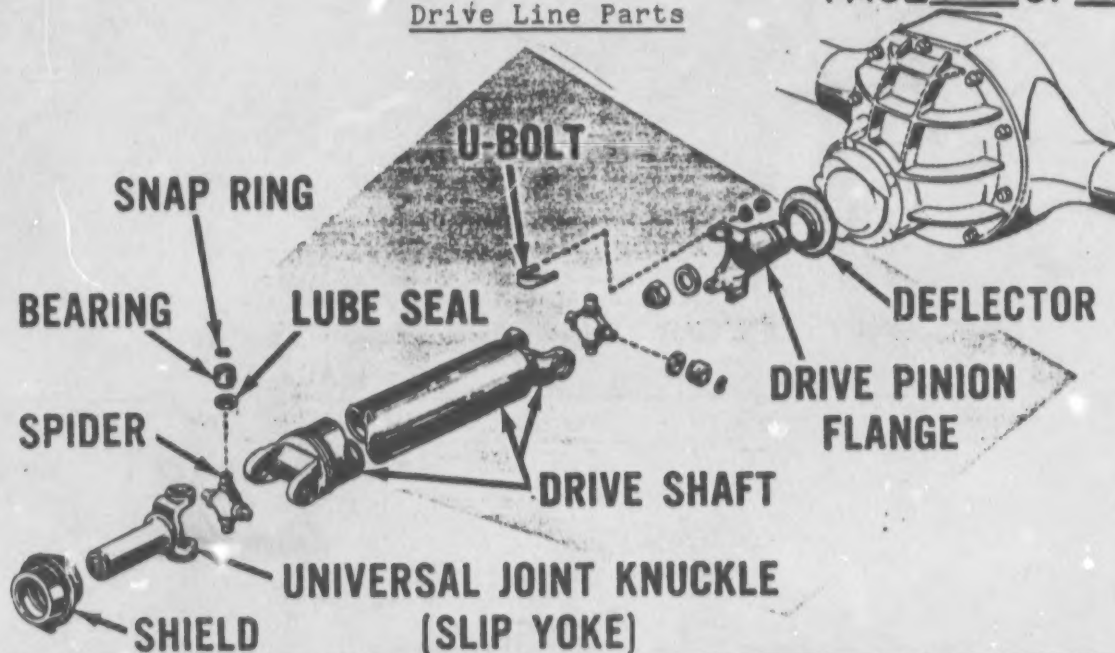
1. Text: Crouse Automotive Mechanic, pages 496 - 500.
2. Instruction Sheet enclosed, Drive Line Parts
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	03	2

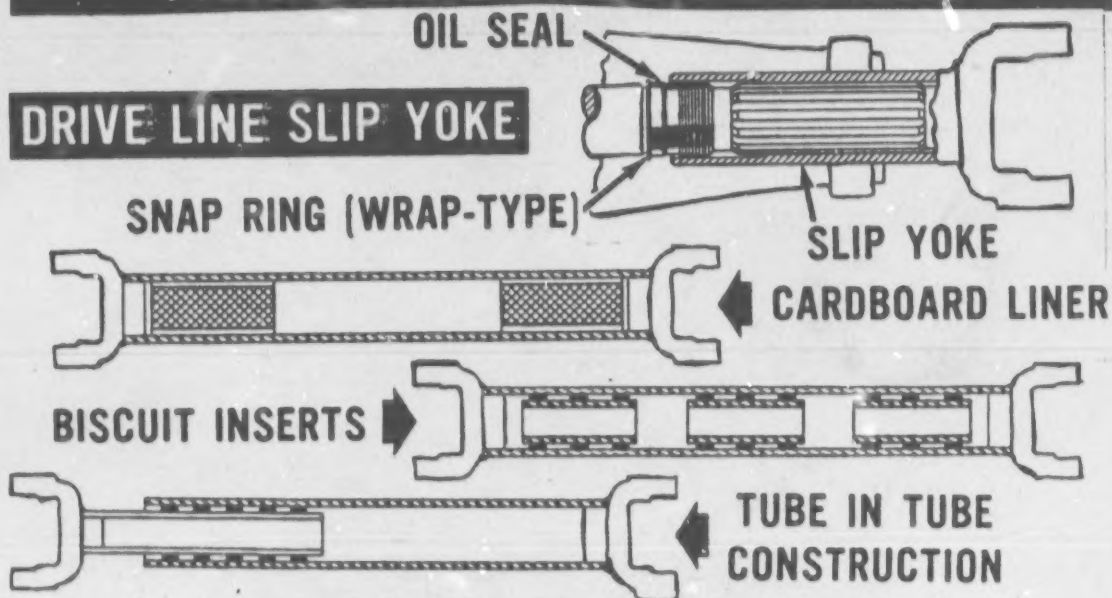
INSTRUCTION SHEET

RVTC

PAGE 1 OF 2

Drive Line Parts**TYPICAL DRIVE LINE-DISASSEMBLED**

OIL SEAL

DRIVE LINE SLIP YOKE**DRIVE SHAFT CONSTRUCTION**

DEPT.	PROG.	DUTY	TASK	EN OBJ.
IN	9043	B	03	2

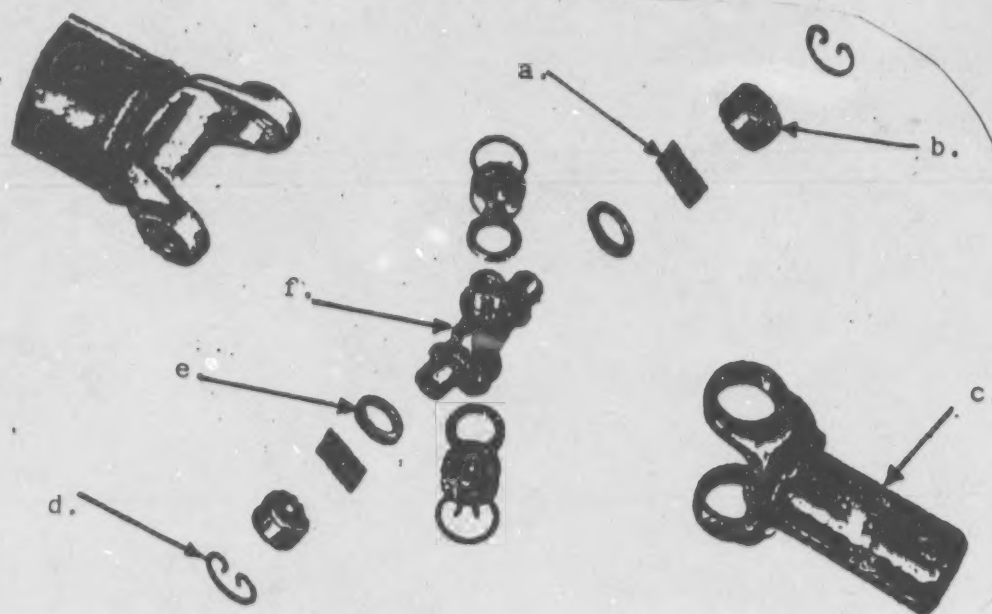
SELF-CHECK

RVTC

Directions

Evaluate your knowledge by identifying the items below on a separate sheet of paper.

1. Yoke
2. Cross (Spider)
3. Seal
4. Snap Ring
5. Needle Bearings
6. Cap



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	03	2

SELF-CHECK

RVTC

Answer Key

1. c
2. f
3. e
4. d
5. a
6. b

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	03	2

ENABLING OBJECTIVE NO. 3

RVTC

Test the mechanical condition of a drive line.

LEARNING STEPS

1. Read Resource No. 1 to identify the method of inspecting a drive line.
2. Practice testing the mechanical condition of a drive line using Resource No. 2.
Have your instructor check your list of needed repairs, if any, as a Self-Check.
3. Go on to Enabling Objective No. 4.

RESOURCES

1. Instruction Sheet enclosed, Inspection of Drive Line
2. Shop vehicle.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	03	3

INSTRUCTION SHEET

RVTC

PAGE 1 OF 2

Inspection of Drive Line Parts

Follow the procedure below to inspect a drive line for worn or damaged parts.

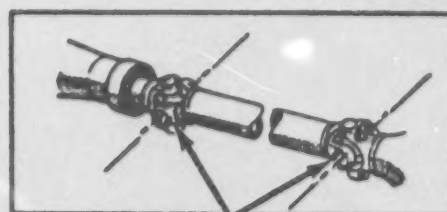
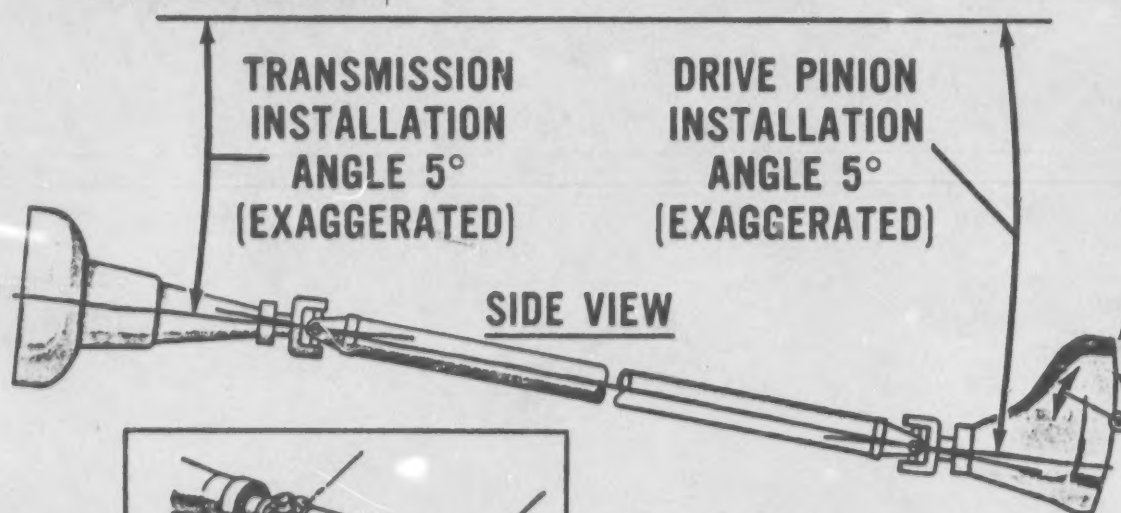
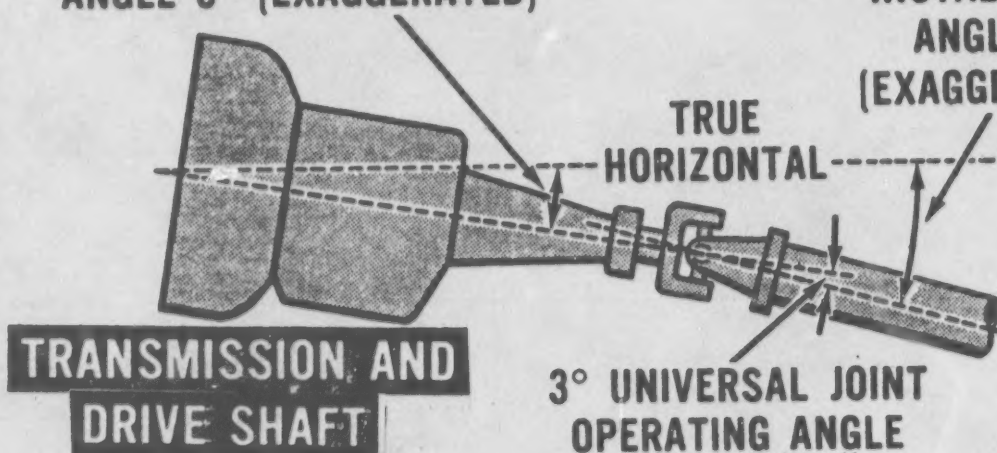
1. While the engine is running, hold the brake and shift the transmission from forward to reverse; any loud clunk can indicate a worn part in the drive line.
2. Any vibration or noise from the area under the vehicle is a good indication of worn parts in the drive line.
NOTE: This step requires a road test and can only be done with your instructor.
3. The following steps are to be done while the vehicle is on a lift and in an overhead position.
3. The inspection should start at the front of the drive train and proceed to the rear, just as power flows from the engine to the rear wheels. It is necessary to inspect one part at a time.
4. Check the slip yoke joint for oil leaks or visible damage. An oil leak would indicate a worn transmission seal or O-ring on yoke.
5. Check the front universal joint for wear, side to side or rotating free play. Check for lack of lubricant and missing or damaged parts such as retaining rings or dust covers.
6. Check the center bearing and support (if vehicle is equipped with one) for wear, missing or damaged parts, such as bolts, dust covers or oil retaining seals.
7. Check the drive shaft for any visible damage (dents). Check for any foreign material such as mud or wire on the shaft. Drive shafts are balanced and any foreign material can cause vibrations which result in excess wear of parts.
8. Check the rear universal joint using the same method as for the front.
9. Check the drive pinion flange and deflector for wear, damage, excess free play or leaks at the pinion seal.
10. Visually inspect for worn or damaged springs and shocks on the rear of the vehicle. Any suspension parts which sag or ride too high can change the angle of the drive train as shown on the following page. Contact the instructor with a list of worn or damaged parts.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	03	3

INSTRUCTION SHEET

RVTC

PAGE 2 OF 2

TRANSMISSION INSTALLATION
ANGLE 5° (EXAGGERATED)DRIVE SHAFT
INSTALLATION
ANGLE 8° (EXAGGERATED)**CANCELLING ANGLES REQUIREMENTS**

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	03	3

ENABLING OBJECTIVE NO. 4
RVTC

Diagnose and repair a drive line.

LEARNING STEPS

1. Inspect components in Resource No. 1 for worn or damaged parts in the drive line.
2. See your instructor with a list of needed repairs, if any.
3. Practice repairing a drive line by removing and installing any worn parts on Resource No. 3a and consulting Resource No. 3b
4. Have your instructor check your work when completed.
5. When you this you can perform this task, take the Performance Test.

RESOURCES

1. Shop vehicle
2. Instructor
3.
 - a. Shop vehicle
 - b. Auto repair manual for shop vehicle you are testing, for Removal and Installation Procedures
4. Instructor

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	03	4

PERFORMANCE TEST FOR TASK NO. B-03

RVTC

TASK: Diagnose and Repair Drive Line

IN-9043-B-03

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: In a shop situation, you will diagnose and repair a drive line on a vehicle provided. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO		
1.	Was the vehicle tested for noise or vibration before it was placed on the lift?				
2.	Were the parts of the drive line inspected from the front to the rear of the vehicle?				
3.	Was each part checked individually rather than several parts at once?				
4.	Was a list made of the parts needing repair?				
5.	Were the parts listed actually in need of repair?				
6.	Were parts removed and replaced according to the manual?				
7.	Were there any worn or damaged parts that were not diagnosed and repaired?				
☐ ATTAINED ☐ NOT ATTAINED Score _____ EVALUATOR'S SIGNATURE _____					
DEPT.	PROG.	DUTY	TASK	ATTEMPT	Page 1 of 1
IN	9043	B	03		

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IN-9043-B-02

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Replace Tires

DUTY:

Performing Maintenance and Repair on Drive Train

PURPOSE :

Mounting and demounting tires can be a difficult and dangerous job if the proper procedures are not followed. Improper mounting of tires may also lead to tire failure which could result in an accident leading to injury or death.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	B	02	Duty A

REVISED

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:****GIVEN:** a tire changer and rim,**YOU WILL:** demount and mount the tire.**HOW WELL:** Your performance will be assessed by your instructor using the Performance Test on page 9.**NOTE:**

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL
INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE,
SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Demount tire from rim.
2. Mount tire on rim.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	02

ENABLING OBJECTIVE NO. 1

RVTC

Demount tire from rim.

LEARNING STEPS

1. Read Resource No. 1 to identify the steps to demount tire.
2. Evaluate your knowledge by completing the Self-Check.
3. Practice demounting a tire from the rim. Make sure the instructor is present.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. a. Text: Crouse Automotive Mechanics, paragraph 58-20, page 580.
b. Instruction Sheet enclosed, Demounting Tires
2. Self-Check enclosed.
3. a. Tire changer
b. Wheel
c. Instructor

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IND	9043	B	02	1

INSTRUCTION SHEET

RVTC

PAGE 1 OF 1Demounting Tires

Follow the procedure below for removing a worn or flat tire from a rim. Pay close attention to all safety precautions.

CAUTION: WEAR SAFETY GLASSES AT ALL TIMES!

1. Remove air from tire if still inflated.

CAUTION: DEMOUNTING TIRE UNDER PRESSURE CAN RESULT IN INJURY AND TIRE DAMAGE!

2. Visually inspect tire for any damage or wear--never repair a badly damaged or worn tire.

3. Secure tire to changer with narrowest flange up--hand tighten centering cone.

4. Rotate tire so valve is in front of you.

5. Lubricate bead of tire with soap solution by applying lubricant all around rim. Always use approved lubricant to prevent tire damage.

CAUTION: KEEP HANDS AWAY FROM TIRE AND RIM.

6. Hook bead breaker over edge of rim and press foot pedal to break bead. Retract bead breaker when bead is broken.

7. Place bead lifting tool in position on center post with flat end of tool between rim and bead.

8. Press foot pedal to remove tire from rim.

9. To remove lower bead, insert tool under lower bead and press foot pedal.

10. Remove tire and rim from changer.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IND	9043	B	02	1

SELF-CHECK**RVTC**Directions

Evaluate your work by answering True or False to the items below on a separate sheet of paper.

1. Holding tires while inflating is a good habit.
2. Caution should be taken only when changing large truck tires, because the automobile tire is not dangerous.
3. 50 PSI is not too much air to seal the bead on auto tires.
4. Soap and water is a good lubricant for tire changing.
5. Oil is a good lubricant for tire changing.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	02	1

SELF-CHECK

RVTC

Answer Key

1. F
2. F
3. F
4. T
5. F

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Activities for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	02	1

ENABLING OBJECTIVE NO. 2

RVTC

Mount tire on rim.

LEARNING STEPS

1. Read Resource No. 1 to identify steps to mount a tire.
2. Practice mounting a tire. :
Make sure the instructor is present.
3. When you think you can perform this task, take the Performance Test.

RESOURCES

1. a. Instruction Sheet enclosed, Mounting Tires
b. Text: Crouse Automotive Mechanics, paragraph 58-25 and 26, page 581.
2. a. Tire
b. Tire changer
c. Instructor
3. Performance Test for task B-02.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IND	9043	B	02	2

INSTRUCTION SHEET

RVTC

PAGE 1 OF 1Mounting Tires

Follow the procedure below for mounting a tire on a rim. Pay close attention to all safety precautions.

CAUTION: WEAR SAFETY GLASSES AT ALL TIMES!

1. Visually inspect tire for any damage or wear.
2. Place the rim on the changer with the narrowest flange up--hand tighten centering cone.
3. Lubricate bead of tire with soap solution.
4. Place tire in position on the rim with as much bead over the rim flange as possible. This provides a starting position for bead lifting tool.
5. Place the bead lifting tool over the center post with the curved end over the lips of the rim and flat tab up. This position will force the bead over the rim when the tool rotates under pressure.

CAUTION: DO NOT STAND WITH YOUR BODY OVER THE TIRE OR WITH YOUR HANDS NEAR THE RIM OR BEAD. THE TIRE CHANGER OPERATES UNDER PRESSURE AND CAN CAUSE INJURY IF SAFETY PRECAUTIONS ARE NOT TAKEN!

6. Press foot pedal to rotate bead lifting tool over rim.
7. At this point one bead is over the rim flange, repeat steps 5,6 and 7 to force the remaining bead over the rim.
8. Loosen the centering cone.
9. Attach the air hose for inflating the tire.

CAUTION: KEEP HANDS AND BODY AWAY FROM TIRE WHILE INFLATING. IF THE TIRE SHOULD EXPLODE YOU COULD BE INJURED.

10. Inflate the tire a small amount at a time, checking the pressure frequently.

NOTE: If bead will not hold air or is not touching the rim press the foot pedal (air inflator) all the way to the floor. This will release a large amount of air under pressure between the rim and bead to expand the tire out to the rim for an air tight seal.

CAUTION: DO NOT EXCEED PRESSURE RECOMMENDED BY TIRE MANUFACTURERS!

11. Install valve stem.
12. Re-check air pressure.
13. Remove tire from changer and submerge in water to check for leaks.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9C43	B	02	2

PERFORMANCE TEST FOR TASK NO. B-02

RVTC

IN-9043-B-02

TASK: Replace Tires

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: In a shop situation, you will mount and demount tires. You will be evaluated for attainment of this task, based upon the items listed below. You must complete this within 20 minutes.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Was air removed from the tire first?		
2.	Was tire visually inspected for wear or damage?		
3.	Was bead lubricated using approved lubricant only?		
4.	Was rim placed on changer with narrowest flange up?		
5.	Were all parts of operator's body away from tire while inflating the tire?		
6.	Was the tire inflated a little at a time to avoid over inflation?		
7.	Did the tire hold air with no leaks?		
8.	Was the task completed within 20 minutes?		

☐ ATTAINED
☐ NOT ATTAINED

Score _____ EVALUATOR'S SIGNATURE _____

DEPT.	PROG.	DUTY	TASK	ATTEMPT
IN	9043	B	02	

Page 1 of 1

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VO-TECH CENTER

7700 State Road 544 N
Winter Haven, Florida 33880

IN-9043-B-01

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Flare and Splice Tubing

DUTY:

Performing Maintenance and Repair on Drive Train

PURPOSE :

Tubing and hoses are used in the brake system, fuel system, transmission, engine, heating system, and the steering system. You need to be able to install, cut, flare, splice and bend tubing and how to use the proper fittings.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	B	01	Duty A

REVISED :

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

GIVEN: access to the tool room and materials,

YOU WILL: flare and splice tubing using the proper fittings and accessories.

HOW WELL: You must successfully complete the Written Test.
Your performance will be assessed by your instructor using the Performance Test on page 15.

NOTE:

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Identify the tools and equipment needed to make the tubing repairs.
2. Describe the process of flaring tubing.
3. Identify fittings, threads and accessories for tubing and hoses.
4. Flare and splice tubing.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	01

ENABLING OBJECTIVE NO. 1

RVTC

Identify the tools and equipment needed to make the tubing repairs.

LEARNING STEPS

1. Read Resource No. 1 to identify tools for cutting tubing.
2. Read Resource No. 2 to identify tools and equipment needed for bending and shaping tubing
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. Text: Introduction to Automotive Mechanics, Unit 1, pages 128 - 129.
2. Text: Introduction to Automotive Mechanics, Unit 1, pages 130 - 131 and page 134, Fig. 4-14.
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	01	1

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. Spring tubing benders are used with tubing that has fittings on the end.
2. Lever tubing benders are used with tubing which does not have fittings on the end.
3. Each spring tube bender is designed to bend only one size tube.
4. The tubing cutter is designed to cut when turned to the open side.
5. The tool used to flare aluminum is a single flaring tool.
6. The tool used to flare steel brake lines is a double flaring tool.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. CLJ.
IN	9043	B	01	1

SELF-CHECK

RVTC

Answer Key

1. F
2. F
3. T
4. T
5. T
6. T

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	01	1

ENABLING OBJECTIVE NO. 2

RVTC

Describe the process of flaring tubing.

LEARNING STEPS

1. Read Resource No. 1 to identify the process of flaring tubing.
2. Evaluate your knowledge by completing the Self-Check.
3. Go on to Enabling Objective No. 3.

RESOURCES

1. Text: Introduction to Automotive Mechanics, Unit 1,
pages 133 - 135.
2. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	01	2

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. A flare fitting is a pressure fitting seal.
2. Copper, steel and plastic tubing can easily be flared.
3. A steel long nut connection is not designed for flare fitting.
4. The die-bar is a good tool to determine tubing size.
5. The two most common types of flares are (a) single lap and (b) double lap flare.
6. Self aligning fittings do not require flaring.
7. Threaded sleeve fittings do not require flaring.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	01	2

SELF-CHECK

RVTC

Answer Key

1. T
2. F
3. F
4. T
5. T
6. T
7. T

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	01	2

ENABLING OBJECTIVE NO. 3

RVTC

Identify fittings, threads and accessories for tubing and hoses.

LEARNING STEPS

1. Read Resource No. 1 to identify fittings, threads and accessories for tubing and hoses.
2. Practice identifying the accessories and fittings using Resource No. 2.
3. When you think you can attain this task, take the Written Test.

RESOURCES

1. Text: Introduction to Automotive Mechanics, Unit 1, pages 135 - 138.
2. Text: Introduction to Automotive Mechanics, Unit 1, pages 139 - 140, Exercise 9.
3. Written Test for task B-01.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	01	3

WRITTEN TEST FOR TASK NO. B-01

RVTC

TASK:

Flare and Splice Tubing

IN-9043-B-01

DirectionsPAGE 1 OF 3

The purpose of this test is to determine if you fully understand how to flare and splice tubing. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Multiple Choice. On the separate Answer sheet, put the letter of the correct answer in the blank to the left of the number of the question.

DO NOT MARK ON THIS TEST!

Multiple Choice questions

1. Automotive tubing is made of which of the following types of material?
 - a. steel
 - b. plastic
 - c. aluminum
 - d. all of the above
2. The double lap flare must be used on:
 - a. copper tubing.
 - b. steel tubing.
 - c. aluminum tubing.
 - d. brass tubing.
3. The most widely used clamp on hose today is the:
 - a. wire clamp.
 - b. regular clamp.
 - c. aircraft clamp.
 - d. c-clamp.
4. Hoses are measured by the:
 - a. outside diameter.
 - b. inside diameter.
 - c. number of plies per foot.
 - d. number of ounces per foot.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	01

WRITTEN TEST FOR TASK NO. B-01

RVTC

TASK: Flare and Splice Tubing

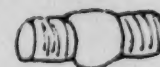
PAGE 2 OF 3

5. Brake systems use which type of tubing?
 - a. aluminum
 - b. copper
 - c. steel
 - d. aluminum and copper
6. A spring bender is used to bend tubing which has:
 - a. compression fittings.
 - b. threaded sleeve fittings.
 - c. 45° fittings.
 - d. self-aligning fittings.
7. Which of the following fittings require flaring?
 - a. compression
 - b. threaded sleeve
 - c. 45° fitting
 - d. self-aligning

The items below are Matching. On the separate Answer Sheet, write the letter of the item that best identifies each item.

Matching questions

1. Tubing cutter
2. Spring tube bender
3. Lever tube bender
4. Male connector
5. Nut
6. Sleeve
7. Drain cock
8. Long nipple



DEPT.	PROG.	DUTY	TASK
IN	9043	B	01

WRITTEN TEST FOR TASK NO. B-01

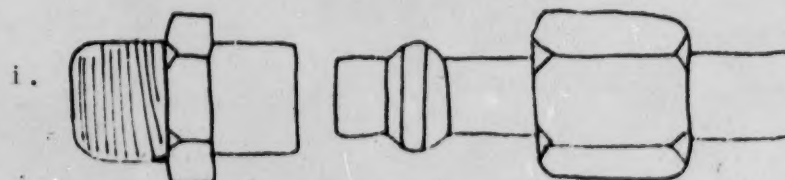
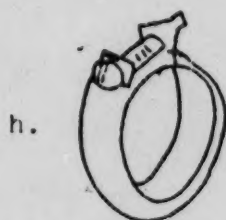
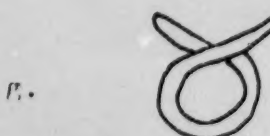
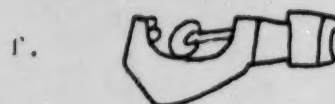
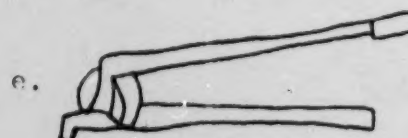
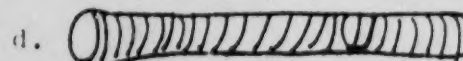
RVTC

TASK:

Flare and Splice Tubing

PAGE 3 OF 3

9. Double male drain cock
10. Threaded sleeve fitting
11. Flared fitting
12. Compression fitting
13. Aircraft
14. Wire
15. Regular



DEPT.	PROG.	DUTY	TASK
IN	9043	B	01

IN-9043-B-01

WRITTEN TEST FOR TASK NO. B-01

RVTC

TASK: Flare and Splice Tubing

ANSWER KEY

PAGE 1 OF 1

Multiple Choice questions

- | | | | | |
|-------------|-----------------|-----------------|-----------------|-----------------|
| <u>a</u> 1. | <u>b</u> 6. | <u> </u> 11. | <u> </u> 16. | <u> </u> 21. |
| <u>b</u> 2. | <u>c</u> 7. | <u> </u> 12. | <u> </u> 17. | <u> </u> 22. |
| <u>b</u> 3. | <u> </u> 8. | <u> </u> 13. | <u> </u> 18. | <u> </u> 23. |
| <u>b</u> 4. | <u> </u> 9. | <u> </u> 14. | <u> </u> 19. | <u> </u> 24. |
| <u>c</u> 5. | <u> </u> 10. | <u> </u> 15. | <u> </u> 20. | <u> </u> 25. |

True-False questions

- | | | | | |
|--------|---------|---------|---------|---------|
| T F 1. | T F 6. | T F 11. | T F 16. | T F 21. |
| T F 2. | T F 7. | T F 12. | T F 17. | T F 22. |
| T F 3. | T F 8. | T F 13. | T F 18. | T F 23. |
| T F 4. | T F 9. | T F 14. | T F 19. | T F 24. |
| T F 5. | T F 10. | T F 15. | T F 20. | T F 25. |

Matching questions

- | | | | | |
|-------------|--------------|--------------|-----------------|-----------------|
| <u>f</u> 1. | <u>n</u> 6. | <u>k</u> 11. | <u> </u> 16. | <u> </u> 21. |
| <u>d</u> 2. | <u>a</u> 7. | <u>i</u> 12. | <u> </u> 17. | <u> </u> 22. |
| <u>e</u> 3. | <u>b</u> 8. | <u>j</u> 13. | <u> </u> 18. | <u> </u> 23. |
| <u>m</u> 4. | <u>c</u> 9. | <u>g</u> 14. | <u> </u> 19. | <u> </u> 24. |
| <u>o</u> 5. | <u>l</u> 10. | <u>h</u> 15. | <u> </u> 20. | <u> </u> 25. |

DEPT.	PROG.	DUTY	TASK
IN	9043	B	01

ENABLING OBJECTIVE NO. 4

RVTC

Flare and splice tubing.

LEARNING STEPS

1. Read Resource No. 1 to identify the steps in flaring and splicing tubing.
2. Practice flaring and splicing tubing using Resource No. 2.
3. When you think you can perform this task, take the Performance Test.

RESOURCES

1. Text: Introduction to Automotive Mechanics, Unit 1, pages 127 - 138.
2. a. Tools
b. Section of brass, steel or aluminum from the material room
3. Performance Test for task B-01.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	01	4

PERFORMANCE TEST FOR TASK NO. R-01

RVTC

IN-9043-B-01

TASK:

Flare and Splice Tubing

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will flare and splice tubing. Select the necessary tools from the tool room and a section of tubing from the material room. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Was the tubing cutter identified and checked out of the tool room?		
2.	Was the flaring tool identified and checked out of the tool room?		
3.	Was the tubing cut by turning the cutting tool in the open direction?		
4.	Was the tube reamed to remove all burrs?		
5.	Was the correct flaring tool selected for the type of tubing (double flare for steel or single for copper, brass or aluminum)?		
6.	Was the single flare (if selected) on a 45° angle?		
7.	Was a flare nut slid over the flare into position?		
8.	Was the flare square with the tubing?		
9.	Were tools and materials returned to the tool room?		

☐ ATTAINED
☐ NOT ATTAINED

Score _____

DEPT.	PROG.	DUTY	TASK	ATTEMPT
IN	9043	B	01	

EVALUATOR'S SIGNATURE _____
 Page 1 of 1

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7700 State Road 544 N
Winter Haven, Florida 33880

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Identify and Use Metric Units

DUTY:

Identifying Orientation Procedures

PURPOSE :

The metric system is currently being adopted in the United States as a unit of measure. An effective mechanic needs to know how to use the metric system.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	A	06	

REVISED :

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STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:****GIVEN:** problems,**YOU WILL:** use metric units.**HOW WELL:** Your performance will be assessed by your instructor using the Performance Test on page 28.**NOTE:**

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Describe the beginning of the metric system.
2. Identify reasons why the metric unit of measure should be used.
3. Convert metric units.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	06

ENABLING OBJECTIVE NO. 1
RVTC

Describe the beginning of the metric system.

LEARNING STEPS

1. Read Resource No. 1 to describe the beginning of the metric system.
2. Evaluate your knowledge by completing the Self-Check.
3. Go on to Enabling Objective No. 2.

RESOURCES

1. Instruction Sheet enclosed.
The Beginning
2. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	A	06	

INSTRUCTION SHEET

RVTC

PAGE 1 OF 5The Beginning

Why do we have 12 inches in a foot instead of a rounded number like 10? Why is a ruler marked off in 16ths or 32nds when it is so difficult to convert a measure such as $9/32$ to a decimal value? Why are there 60 seconds in a minute, 60 minutes in an hour, but only 24 hours in a day? The answer to these questions are rooted within the system the world has used for several thousand years.



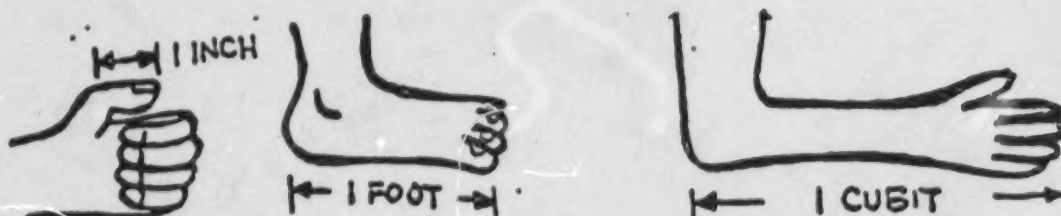
Early measurement systems (and thus mathematical systems) came out of necessity to measure off frequently flooded fields and in the trading of merchandise. Every measure of the customary system has a different story behind it. One ancient country used a base two type of system and thus gave us measures which are converted to others using the number 2 (i.e., 2 pints equals one quart, 4 quarts equals one gallon, etc.) Another country used a base 6 and 60 systems. Thus, we have 60 seconds in a minute, 360° in a circle, etc. These countries usually measured length using body parts. Thus, we now still use feet, yards, miles, fathoms, hands, paces and many others.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	06	1

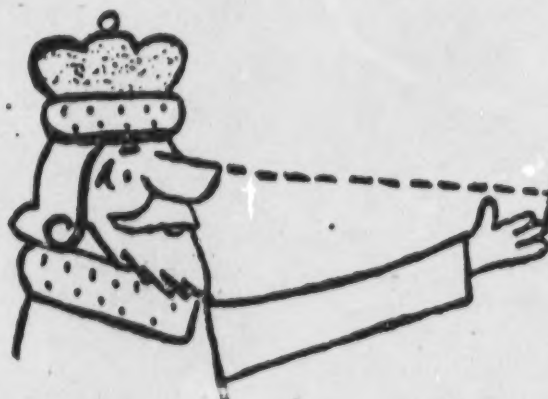
INSTRUCTION SHEET

RVTC

PAGE 2 OF 5



Obviously, an individual with a small body was at a trading disadvantage with a large man. This caused for disparity as to definitions of length. In an attempt to standardize measures, the basic lengths used were referred to parts of the King's body. (Using their own systems)



At the same time, the different countries began trading with each other. This called for a whole new set of conversions between measures. The final outcome, then, was that the Customary System retained the most frequently used measures and their interconversions. Thus, almost every measurement change we use involves a different conversion number. The system had no scientific or mathematical logic behind it. Compare this to the formation of the metric system. The basic thought behind the base ten system of measure came about in the 1600's by a gentleman in France named Gabriel Mouton. People saw the advantages of his system but had no desire or reason to switch for over 100 years. However, during the French Revolution (late 1700's) the aristocracy was thrown out of power. This meant that the system of measure based upon the lengths of the King's body, had to be revamped. The French Academy was commissioned to derive a system not based on the length of body parts. Using Mouton's basic ideas, they based the new system on an unchanging distance--the distance from the North Pole to the Equator. This distance was cut up into ten

DEPT	PROG	DUTY	TASK	EN OBJ
IN	9043	A	06	1

parts, then each of these units into 10 parts, etc. until a workable size was attained. This distance was one ten-millionth of the original North Pole--Equator measure. This basic unit of length was referred to as one measure or as the French word was used--metre. Thus the metre (meter) was called the basic length standard for the metric system.



Other units of length, capacity and mass were derived from this base unit. Within the system that was built or improved upon by the French Academy, the constant factor used to change measures was the number 10.

10

This number was an easy one to work with because multiplication and division with 10 is most easily accomplished by simply shifting the decimal point. Also, addition and subtraction of decimal values is an uncomplicated process.

For example:

$3.52 \times 10 = 35.2$	$8.3 \div 10 = .83$
$.0059 \times 100 = 0.59$	$.54 \div 100 = .0054$
$9 \times 1000 = 9000$	$802 \div 1000 = .802$

DEPT	PROG	DUTY	TASK	EN OBJ
IN	9043	A	06	1

INSTRUCTION SHEET

RVTC

PAGE 4 OF 5

Multiplication by 10, 100, or 1000 (all powers of 10) is most easily accomplished by moving the decimal point in the original number to the right as many places as there are zeros in the number.

Exercise 1-1

- | | | |
|-----------------------|----------------------|------------------------|
| a. 14.5×100 | e. $2053 \div 1000$ | i. 817.2×1000 |
| b. $1.29 \div 10$ | f. $1.92 \div 100$ | j. $46 \div 1000$ |
| c. 2.68×1000 | g. $.086 \times 10$ | k. $.0954 \times 100$ |
| d. 5×10 | h. $1.0005 \div 100$ | l. $192000 \div 10$ |

The mass capacity and length intraconversions are also based on a one for one match-up between certain size values within the system. Upon completion of their new system, the French offered their system to the world. However, the world was not ready for this change. England, the major trading nation in the world, was in the middle of their constant feud with France. They refused to believe that anything that was developed in France could be worthy of any of their attention. England, thus, was one of the last nations to make the metric conversion.

France had one advantage at this point in time. Their scientists were considered to be among the best in the world. Therefore, many nations sent their scholars to France to study under the French scientists. An offshoot of this schooling was that most of the more famous scientists in the world became used to using the metric conversions. They saw its many advantages, used it, and took this new measurement system back to their home countries. As a result, one of the first professions to convert entirely to metric was scientific work and research.

Upon returning to their home countries, these scholars became salespeople for the metric system. Slowly, but surely, the countries around France, then Europe, North America, etc. began conversion to metric.

In America, Thomas Jefferson tried to adapt this country's measures to a metric based style of measure. He first introduced legislation to have the foot divided into 10 parts rather than 12 inches. Upon failure of this, he tried other adaptations, none of which the Continental Congress deemed necessary. John Adams also pushed strongly for metric measure but his pleas were also ignored.

Metric measure was introduced into Congress many times thereafter. Fourteen metric bills were introduced into the Congress in the 1800's, and 36 during the first 30 years of this century.

In 1902, metric legislation was set to be passed in both the House and Senate. A large group was behind the legislation and both pro and anti-metric forces were positive that metric legislation would be passed. Due to an abnormally early adjournment in Congress that year, the bill was put off until the next session. Anti-metric forces began

DEPT	PROG	DUTY	TASK	EN.OBJ
IN	9043	A	06	1

INSTRUCTION SHEET

RVTC

PAGE 5 OF 5

pressure campaigns during the adjournment. Pressure became so great that the bill's sponsor withdrew it, even though he still had enough votes for passage.

Many metric bills were then sponsored with little support (because of industry lobbies) until 1957. At that time, Russians sent their Sputnik into space. This country's scientists, mathematicians and defense department came under heavy fire from individuals for not being the first in space, thus relinquishing our claim to being the most technological nation in the world. As a by product, studies were done to see why we did not get off the ground first. The results of the study showed several things, one of which was the use of an out-moded measurement system in this country.

DEPT	PROG	DUTY	TASK	EN OBJ
IN	9043	A	06	1

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by answering the items below on a separate sheet of paper.

1. Early units of measure were based upon:
 - a. shadows of the sun.
 - b. rock sizes.
 - c. parts of the body.
 - d. none of the above.
2. The meter was defined (originally) as:
 - a. 1/10,000ths of the distance from the North Pole to the Equator.
 - b. 1/1000ths of the distance from Paris to Dunkirk.
 - c. 1000 inches.
 - d. none of the above.
3. The number 10 is used in the metric system because:
 - a. it's easy to multiply and divide.
 - b. you need only shift the decimal point.
 - c. addition and subtraction on values is complicated.
 - d. all of the above
4. The switch to metric almost came about in 1902. The reason it did not was because:
 - a. it did not have sufficient backing.
 - b. there was too much pressure from industry.
 - c. the public was against it.
 - d. other congressional action caused it to not come to vote.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	06	1

SELF-CHECK

RVTC

Answer Key

1. d
2. a
3. d
4. b

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	06	1

ENABLING OBJECTIVE NO. 2

RVTC

Identify reasons why the metric unit of measure should be used.

LEARNING STEPS

1. Read Resource No. 1 to identify the reasons for changing to the metric system.
2. Read Resource No. 2 to identify the United States System. Complete the exercises.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 3.

RESOURCES

1. Instruction Sheet enclosed, Why Change
2. a. Text: Applied Business Mathematics, 10th Edition, page 504. *See note below
b. Exercises enclosed.
3. Self-Check enclosed.

*Apply especially the last two paragraphs.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	A	06	2

INSTRUCTION SHEET

RVTC

PAGE 1 OF 1Why Change?

Quite frequently individuals will attempt to defend the use of the English system of measure. Their arguments hinge on two concepts:

The tradition associated with the English (Customary) system has been ingrained into Americans for over 200 years. Tampering with this tradition will cause great hardships on all individuals in the young adult and older classifications (the "You can't teach an old dog new tricks" concept).

The English system is an easy system to work with and conversion would be very costly. It is a system that Americans can use because they have been taught the concepts at home and in school.

To overcome these two basic arguments requires some logic and some proof of ability to use our present system. A discussion of costs will be given in a later section. Holding onto an outmoded system of measure, such as ours, simply because of tradition is comparable to driving a car when air transportation is available. Driving the car will surely get you there but it takes longer and takes more mental alertness with more chance for error than the airplane ride. The biggest trouble with air transportation is getting off the ground (i.e., getting to and from the airport, what to take with you, etc.). Yet, when one has flown for three hours and saved a two day drive it is considered well worth the trouble. In the same way, metrication is the airplane travel of measurement systems. It takes a lot of preparation to overcome the first big trip, but worth the preparations. No country in the history of the world has ever converted to the Metric System and then later changed to any other system.

Now that Great Britain and her commonwealth have begun metric conversion, the United States stands alone as a major industrial and trading nation using the Customary System of measure. The House of Representatives, between Watergate woes, has defeated the metric bill. However, the majority of voters against the bill argued that they voted the way they did because of technicalities in bill wording, not the contents of the bill. Hopefully, soon the United States will make the last big step to the conversion. Without government committal to the system, the major businesses, who deal only within the United States' boundaries, will not put forth the time and money to make the conversion. The international businesses will convert to metric as they wish and because there are several ways to do this, they will insist that all companies do it to meet their standards.

DEPT	PROG	DUTY	TASK	EN OBJ
IN	9043	A	06	2

EXERCISE 1

RVTC

Directions

Evaluate your knowledge by writing True or False to the items below on a separate sheet of paper.

- | | |
|---------------------------------------|---------------------------------|
| 1. 12 inches = 1 foot | 32. 4 qts. = 1 gal. |
| 2. 12 feet = 1 yard | 33. 8 qts. = 1 peck |
| 3. 36 inches = 1 yard | 34. 8 pecks = 1 bu. |
| 4. 3 feet = 1 rod | 35. 30 days approximate a month |
| 5. 5,280 feet = 1 mile | 36. 365 days = 1 yr. |
| 6. 1,000 yards = 1 mile | 37. 52 weeks = 1 yr. |
| 7. 12 square inches = 1 square foot | |
| 8. 3 square feet = 1 square rod | |
| 9. 3 square yards = 1 square rod | |
| 10. 5,280 feet = 1 acre | |
| 11. 1,000 square yards = 1 acre | |
| 12. 100 square rods = 1 acre | |
| 13. 640 acres = 1 square mile | |
| 14. 1,000 cubic inches = 1 cubic foot | |
| 15. 9 cubic feet = 1 cubic yard | |
| 16. 60 seconds = 1 minute | |
| 17. 60 minutes = 1 hour | |
| 18. 24 hours = 1 day | |
| 19. 7 days = 1 week | |
| 20. 10 ounces = 1 pound | |
| 21. 2,000 pounds = 1 ton | |
| 22. 2,400 pounds = 1 long ton | |
| 23. 1 tbsp. = 1 fluid ounce | |
| 24. 8 fluid ounces = 1 cup | |
| 25. 16 fluid ounces = 1 pint | |
| 26. 32 fluid ounces = 1 quart | |
| 27. 4 pints = 1 gallon | |
| 28. 2 tsp. = 1 tbsp. | |
| 29. 16 tbsp. = 1 cup | |
| 30. 2 cups = 1 pint | |
| 31. 4 pints = 1 quart | |

EXERCISE 1, 2 and 3

RVTC

Exercise 1 -- Answer Key

1. T	7. F	13. T	19. T	25. T	31. F
2. F	8. F	14. F	20. F	26. T	32. T
3. T	9. F	15. F	21. T	27. F	34. F
4. F	10. F	16. T	22. F	28. F	35. T
5. T	11. F	17. T	23. F	29. T	36. T
6. F	12. F	18. T	24. T	30. T	37. T

Exercise 2

Evaluate your knowledge by putting the correct answer on a separate sheet of paper.

- How many ounces are there in $14\frac{1}{2}$ pounds?
 - divide by 16
 - multiply by 16
 - divide by $14\frac{1}{2}$
 - multiply by $14\frac{1}{2}$
- Police confiscated 85 ounces of heroin. How many pounds is this?
 - divide by 8.5
 - divide by 16
 - multiply by 16
 - multiply by 8.5
- A football field is 120 yards long (including the end zones). How many inches is this?
 - multiply by 36 inches
 - multiply by 3 feet
 - divide by 36 inches
 - divide by 3 feet
- Bill is 67 inches tall. How many feet is this?
 - multiply 12 by 67
 - divide by 12
 - multiply 5.7 by 12
 - divide by 5.7
- A recipe calls for $1\frac{1}{2}$ quarts of orange juice. How many cups is this?
 - divide by $1\frac{1}{2}$
 - multiply by $1\frac{1}{2}$
 - multiply by 4
 - divide by 4

EXERCISE 1, 2 and 3

RVTC

6. One cubic foot of water weighs about 64 pounds. How much does 27 cubic inches weigh?
- multiply 64 by 27
 - multiply 64 by 1728
 - multiply 1728 by 27
 - divide 1728 into 27, then multiply by 64
7. You have ordered 3 cubic yards of black dirt. Your wheelbarrow holds 2 cubic feet in a load. How many wheelbarrow loads will it take to move the pile?
- 3 cubic yards X 2 cubic feet
 - multiply 27 by 3, then divide by 2
 - multiply 3 X 3, then divide by 2
 - multiply 3 X 9, then divide by 2

Exercise 2 -- Answer Key

- b
- b
- a
- b
- c
- d
- b

Exercise 3

The problem with explaining this system to anyone else is that most Americans do not have a good grasp of the system except for the most basic length and time concepts.

Evaluate your knowledge by answering the following questions on a separate sheet of paper.

- 1.
- | | | |
|----------|-----------|---------|
| 3 tons | 1282 lbs. | 12 ozs. |
| + 5 tons | 1942 lbs. | 8 ozs. |
- 8 tons 3186 lbs. 20 ozs.
 - 9 tons 3186 lbs. 20 ozs.
 - 9 tons 1225 lbs. 4 ozs.
 - 10 tons
- 2.
- | | | |
|----------|-----------|---------|
| 5 tons | 250 lbs. | 10 ozs. |
| - 2 tons | 1250 lbs. | 11 ozs. |
- 7 tons 1500 lbs. 21 ozs.
 - 7 tons 1591 lbs. 5 ozs.
 - 2 tons 999 lbs. 15 ozs.
 - 2½ tons

EXERCISE 1, 2 and 3

RVTC

- 3.
- | | | | |
|----|------------|----------|---------|
| | 8 gallons | 2 quarts | 1 pint |
| | | X | 4 |
| a. | 32 gallons | 8 quarts | |
| b. | 34 gallons | 2 quarts | |
| c. | 34 gallons | 2 pints | |
| d. | 32 gallons | 8 quarts | 4 pints |
4. 2 miles 240 yards ÷ 5
- a. 752 yards
b. 48 rods
c. 2256 feet
d. both a and c
- 5.
- | | | | |
|----|-----------|----------|---------|
| | 2 gallons | 2 quarts | 2 pints |
| + | 3 gallons | 3 quarts | 1 pint |
| a. | 5 gallons | 5 quarts | 2 pints |
| b. | 5 gallons | 6 quarts | |
| c. | 6 gallons | 0 quarts | 2 pints |
| d. | 6 gallons | 2 quarts | 1 pint |
- 6.
- | | | | |
|----|-----------|---------|-----------|
| | 12 yards | 2 feet | 11 inches |
| | | X | 9 |
| a. | 108 yards | 18 feet | 99 inches |
| b. | 116 yards | 2 feet | 3 inches |
| c. | 117 yards | | |
| d. | 109 yards | 17 feet | 99 inches |
- 7.
- | | | | |
|----|---------|--------|---------------|
| | 3 yards | 1 foot | |
| - | 1 yard | 2 feet | 1/8 inch |
| a. | 2 yards | 0 feet | 11 inches |
| b. | 2 yards | 1 foot | 11 7/8 inches |
| c. | 1 vard | 1 foot | 11 7/8 inches |
| d. | 4 yards | 3 feet | 1/8 inch |
8. 6 tons 892 lbs. 4 ozs.
- | | | | |
|----|---------|-----------|---------|
| | | | 4 |
| a. | 24 tons | 3568 lbs. | 16 ozs. |
| b. | 1 ton | 1223 lbs. | 1 oz. |
| c. | 1½ tons | | |
| d. | 2 tons | 223 lbs. | 1 oz. |

Exercise 3 -- Answer Key

1. c
2. c
3. b
4. d
5. d
6. b
7. c
8. b

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by answering the item below on a separate sheet of paper.

1. The disadvantage(s) to our present number system is/are:
 - a. too many conversion numbers to remember.
 - b. conversion values are difficult to work with.
 - c. difficulty in adding, subtracting, multiplying and dividing.
 - d. all of the above
 - e. none of the above

Now check your answer with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	A	06	2

SELF-CHECK

RVTC

Answer Key

1. d

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	06	2

ENABLING OBJECTIVE NO. 3

RVTC

Convert metric units.

LEARNING STEPS

1. Read and complete Resource No. 1 to identify the procedure for converting metric units, lengths and distances.
2. Read and complete Resource No. 2 to convert metric units, capacity (liquid) and weight.
3. Evaluate your knowledge by completing the Self-Check.
4. When you think you can perform this task, take the Performance Test.

RESOURCES

1. a. Text: Applied Business Mathematics, pages 507 - 508, 511. Do Exercise 6.
b. Answer Key
c. Instruction Sheet enclosed, The Big Change
2. a. Text: Applied Business Mathematics, pages 512 and 514. Do Exercise 7.
b. Answer Key
3. Self-Check enclosed.
4. Performance Test for task A-06.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	A	06	3

Answer Key

RVTC

Exercise 6

1. $910 \text{ km} \times .6214 = 565 \text{ miles}$
2. $16.5 \text{ miles} \div .6214 = 26.5 \text{ or } 27 \text{ km per gallon}$
3. $540 \text{ inches} \div 30.3701 = 13.7 \text{ m or } 14 \text{ m}$
4. $30 \text{ m} \times 39.3701 = 1181.103 \text{ inches}$
 $1181.103 \div 12 = 98 \text{ feet}$
5. $.5 \text{ inches} \div .0394 = 21.5 \text{ or } 22 \text{ cm}$
6. $8.5 \text{ inches} \div .3937 = 21.5 \text{ or } 22 \text{ cm}$
 $11 \text{ inches} \div .3937 = 27.9 \text{ or } 28 \text{ cm}$
Paper is 22 cm x 28 cm

INSTRUCTION SHEET

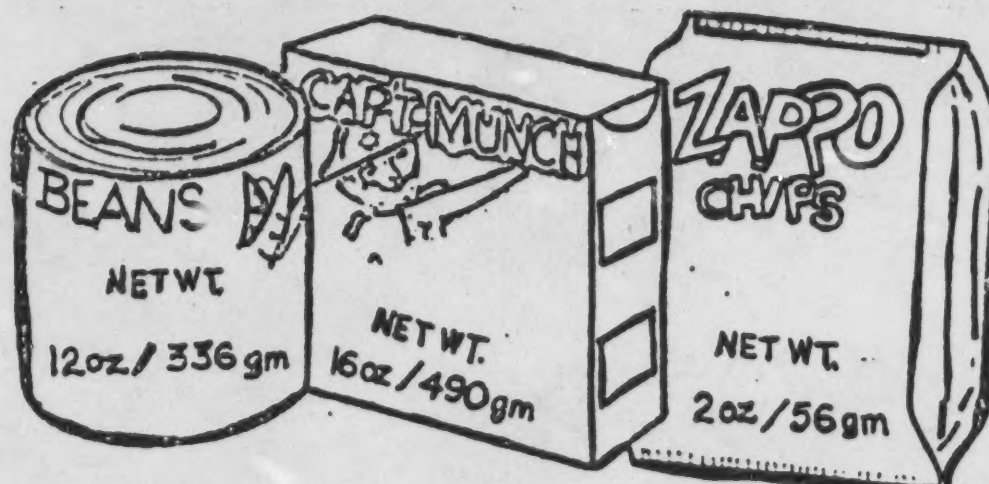
RVTC

PAGE 1 OF The Big Change

In past sections, you have learned the advantages of the metric system. These advantages would be world-wide. We have deliberately not discussed the customary system, nor have we tried to compare both systems. A comparison between systems tends to make the metric system seem somewhat illogical and requires the memorization of some rather long decimal numbers. The best situation is to have a system contain either all customary measures or, preferably, all metric measures. However, during a conversion process, both types of measure will be in use for possibly 50 years. Slowly, but surely, customary measures will disappear. Your generation is the one chosen to spearhead any possible conversion. Quite frankly, this could present quite a large problem.

Without proper guidance, adequate educational classes, advanced publicity, and a host of other plans, the conversion would be burdensome to all individuals in this country.

Experience in other countries has shown us that this change of systems can be brought about with a minimum of effort provided the correct leadership is shown. When you consider that almost everything which has dimensions can be changed, you start realizing the realm that the metric system conversion entails.



Conversion costs are roughly estimated at this time to be approximately \$500,000,000,000. This would include changing everything (speedometers, nuts, bolts, paper, recipes, machinery, etc.) to metric dimensions. This cost seems high, but includes replacement of machines that are worn out, books that are in normal replacement anyway, paper that need only be cut to different sizes and others. Many segments of your

DEPT	PROG	DUTY	TASK	EN OBJ
IN	9043	A	06	3

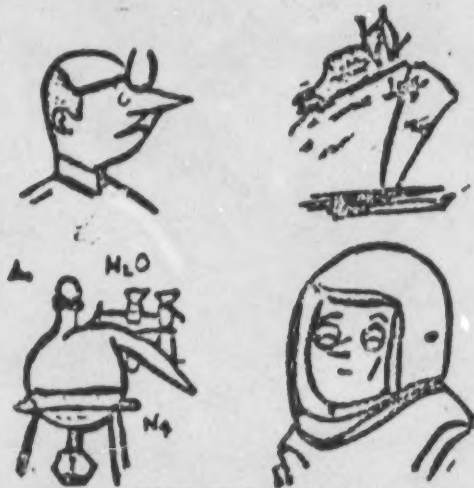
INSTRUCTION SHEET

RVTC

PAGE 2 OF

environment are already converted to metric. Listed below are places where you can already observe changes:

1. Pharmaceuticals
2. NASA
3. Scientific Research
4. Radio Frequency
5. Hospital Records
6. Cigarette Manufacturing
7. U.S. Army
8. Doctors and Dentists
9. Optometry
10. Weights of U.S. Coins
11. U. S. Automobiles
12. Foreign Cars
13. Ball and Roller Bearings
14. Photographic Film and Equipment
15. Swimming Pools
16. Outfield Fence Distance Markers at Met Stadium (Twins)



For those segments of the society, there still be virtually no change except that they will no longer have to make the reverse conversions for individuals who did not understand the original conversions.

Approximating

For the majority of people, being able to perform conversions between systems using an approximation will be feasible if the conversions are simple enough to be done mentally. A large share of the consumer conversion will take place on this approximation standpoint. If someone asked you the distance to the nearest gas station, your answer would probably be an approximate answer. In the same manner, approxi-

DEPT	PROG	DUTY	TASK	EN OBJ
IN	9043	A	06	3

INSTRUCTION SHEET

RVTC

PAGE 3 OF

mations will be used in metrics. By working with and remembering the English Metric approximations listed below, you will become a mini-expert on the conversions.

A meter is only a little more ($1/10$ or 10%) than a yard: therefore, 50 meters is approximately equal to 55 yards. Conversely: 50 yards equals 45 meters.

A liter is a little more than a quart (5%); therefore, 12 liters = 15 quarts. Conversely: 20 quarts (5 gallons) = 19 liters.

1 liter



1 quart

A kilometer is about $2/3$ of a mile; therefore, 15 km = 10 miles. Conversely: 30 miles = 45 km

1 mile

1 km

A gram is a small unit of mass = $1/30$ ounce; therefore, 60 grams = 2 ozs. and 5 ozs. = 150 grams.

1 gram



1 ounce

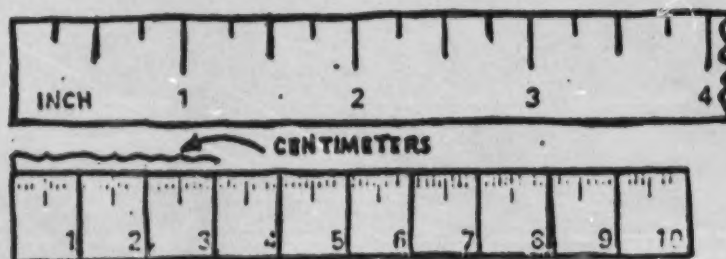
DEPT	PROG	DUTY	TASK	EN OBJ
IN	9043	A	06	3

INSTRUCTION SHEET

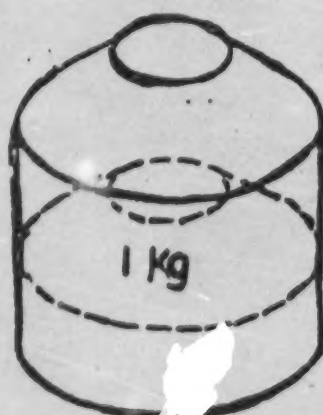
RVTC

PAGE 4 OF 5

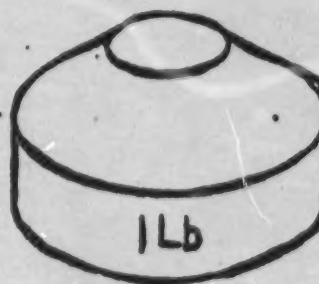
A centimeter is about $\frac{2}{5}$ of an inch; therefore, 25 cm = 10 inches, and 30 inches = 75 cm.



One kilogram is a little more than 2 pounds (10%); therefore, 5 kilograms = 11 pounds and 20 lbs. = 9 kg.



2.2 Lbs = 1 Kg



DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	06	3

Answer Key

RVTC

Exercise 7

1. $2 \text{ kg} + 15 \text{ kg} + 120 \text{ kg} + 48 \text{ kg} + 33 \text{ kg} = 218 \text{ kilograms}$, total weight
2. $2.15 \text{ kg} + .75 \text{ kg} + 1.50 \text{ kg} + .85 \text{ kg} + 1.654 \text{ kg} = 6.904 \text{ kilograms}$, total weight of order
3. $226.8 \text{ g} + 113.4 \text{ g} + 113.4 \text{ g} + 28.35 \text{ g} + 81.59 \text{ g} + 35.44 \text{ g} = 598.98 \text{ grams}$, total weight of spices
4. $.2 \text{ kg} + .5 \text{ kg} + .1 \text{ kg} + 1 \text{ kg} = 1.8 \text{ kilograms}$, total weight of nutmeats
5. $2.358 \text{ kg} - 1.976 \text{ kg} = .382 \text{ kilograms}$ lost in trimming
6. $32 \times 14.75 \text{ kg} = 472 \text{ kilograms}$, total weight of blocks
7. (a) $(1.5 \times 1000) \text{ g} \div 75 = 20 \text{ servings}$
(b) $\$3 \div 20 = 15\text{¢}$ cost per serving
8. (a) $2.4 \text{ kg} \times \$3 = \$7.20$ cost of roast
(b) $(2.4 \times 1000) \text{ g} \div 8 = 300 \text{ grams}$ per serving
(c) $\$7.20 \div 8 \text{ g} = 90\text{¢}$ per serving
9. (a) $100 \times \$2.50 = \$250$ cost of paper
(b) $(100 \times 2.25 \text{ kg} \div 100) = 2.25$ hundred kilogram
(c) $\$250 + (2.25 \text{ kg} \times \$3.40) = \$257.65$ cost of packages
10. $34 \text{ lbs.} \div 2.2046 = 15.4 \text{ kilograms}$, weight of packages
11. $2.2046 \times 10.5 \text{ kg} = 23.1483$ or 23 pounds
12. $100 \div 1.1023 = 90.7$ or 91 metric tons, shipment weight

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by solving the following problems, using these conversion tables. Use a separate sheet of paper.

Conversion Table for Linear (Length)

- 1 meter = 39.3701 inches
- 10 meters = 32.8084 feet
- 100 meters = 328.0840 feet
- 1,000 meters = .6214 mile
- 1 kilometer = .6214 mile

Conversion Table for Capacity (Liquid)

- 1 centiliter = .3381 fluid ounces
- 1 deciliter = .2113 pint
- 1 liter = 1.0567 quarts
- 10 liters = 2.6417 gallons

Conversion Table for Weight

- 1 gram = .0353 ounce
- 10 grams = .3527 ounces
- 1 kilogram = 2.2046 pounds
- 1,000 kilograms = 1.1023 tons

Problems

1. 196.8508 inches = _____ meters.
2. 40 meters = _____ feet.
3. 20 kilometers = _____ miles
4. 10 gallons = _____ liters
5. 5 liters = _____ quarts
6. 6 fluid ounces = _____ centiliters
7. 1.0581 ounces = _____ grams
8. 15 kilograms = _____ pounds
9. 2,000 kilograms = _____ tons

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	06	3

SELF-CHECK

RVTC

Answer Key

1. 5 meters
2. 131.2336 feet
3. 12.4280 miles
4. 37.8544 liters
5. 5.2835 quarts
6. 17.7462 centiliters
7. 29.9745 grams
8. 33.0690 pounds
9. 2.2046 tons

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	06	3

PERFORMANCE TEST FOR TASK NO. _____

RVTC

TASK:

Identify and Use Metric Units ✓

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will identify and use metric units. You will be evaluated for attainment of this task, based upon the item listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO										
1.	Were all problems answered correctly?.....												
Score _____ ☐ ATTAINED ☐ NOT ATTAINED EVALUATOR'S SIGNATURE _____ _____ <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 15%;">DEPT.</th> <th style="width: 15%;">PROG.</th> <th style="width: 15%;">DUTY</th> <th style="width: 15%;">TASK</th> <th style="width: 15%;">ATTEMPT</th> </tr> <tr> <td>IN</td> <td>9043</td> <td>A</td> <td>06</td> <td></td> </tr> </table>		DEPT.	PROG.	DUTY	TASK	ATTEMPT	IN	9043	A	06		Page <u>1</u> of <u>1</u>	
DEPT.	PROG.	DUTY	TASK	ATTEMPT									
IN	9043	A	06										

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VO-TECH CENTER

7700 State Road 544 N
Winter Haven, Florida 33880

IN-9043-A-05

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Identify and Read Scales of Various Measuring Instruments

DUTY:

Identifying Orientation Procedures

PURPOSE :

The quality of your work, as a mechanic, will depend on your ability to read and use measuring instruments accurately. This Learning Guide will aid you in identifying these measuring tools and show you how to use them.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	A	05	

REVISED				

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

GIVEN: measuring instruments and various scale readings,

YOU WILL: identify the measuring instruments and readings.

HOW WELL: Your performance will be assessed by your instructor using the Performance Test on page 17.

ENABLING OBJECTIVES:

1. Identify various measuring instruments.
2. Identify scale readings.
3. Identify vernier caliper readings.
4. Identify micrometer readings.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	05

ENABLING OBJECTIVE NO. 1

RVTC

Identify various measuring instruments.

LEARNING STEPS

1. Read Resource No. 1 to identify the measuring instruments.
2. View Resource No. 2 for use in identifying measuring instruments.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. a. Text: Automotive Mechanics, pages 50 - 52.
b. Text: Automotive Encyclopedia, pages 39 - 43.
2. Display board
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	A	05	1

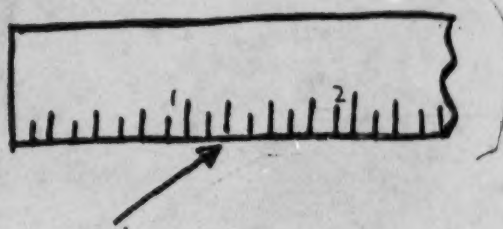
SELF-CHECK

RVTC

Directions

Evaluate your knowledge by identifying the items below on a separate sheet of paper.

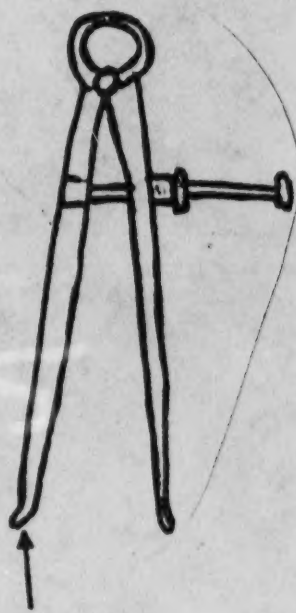
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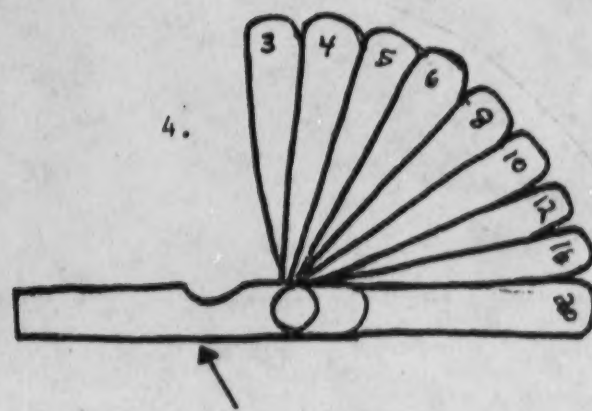
3.



2.



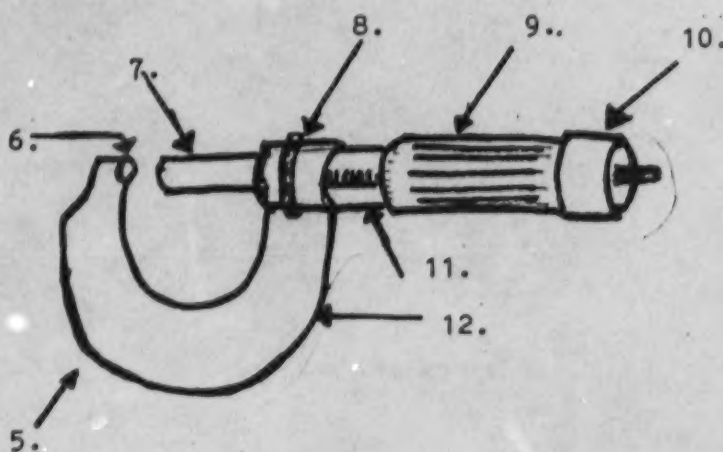
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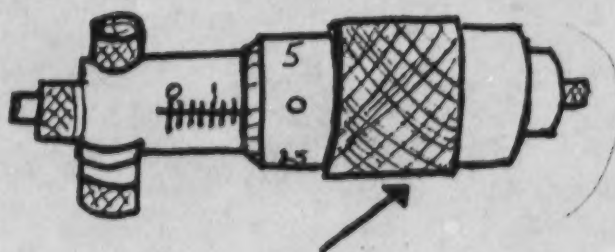
DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	05	1

SELF-CHECK

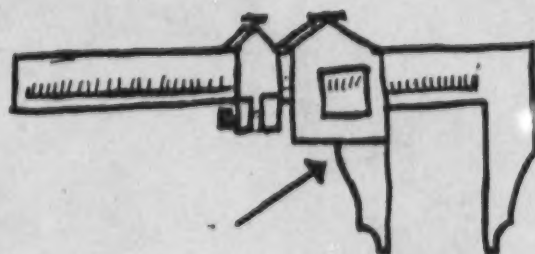
RVTC



13.



14.



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	05	1

SELF-CHECK

RVTC

Answer Key

1. ruler
2. inside caliper
3. outside caliper
4. feeler gauge
5. micrometer (outside)
6. anvil
7. spindle
8. lock nut
9. thimble
10. cap
11. barrel
12. frame
13. micrometer (inside)
14. vernier caliper

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	05	1

ENABLING OBJECTIVE NO. 2

RVTC

Identify scale readings.

LEARNING STEPS

1. Read Resource No. 1 which describes the use of a scale.
2. Before going on to the next Enabling Objective check with your instructor.

RESOURCES

1. a. Text: Automotive Mechanics, page 50.
- b. Text: Automotive Encyclopedia, pages 39 - 41.
- c. Instruction Sheet enclosed, Explanation of Graduations

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	A	05	2

INSTRUCTION SHEET

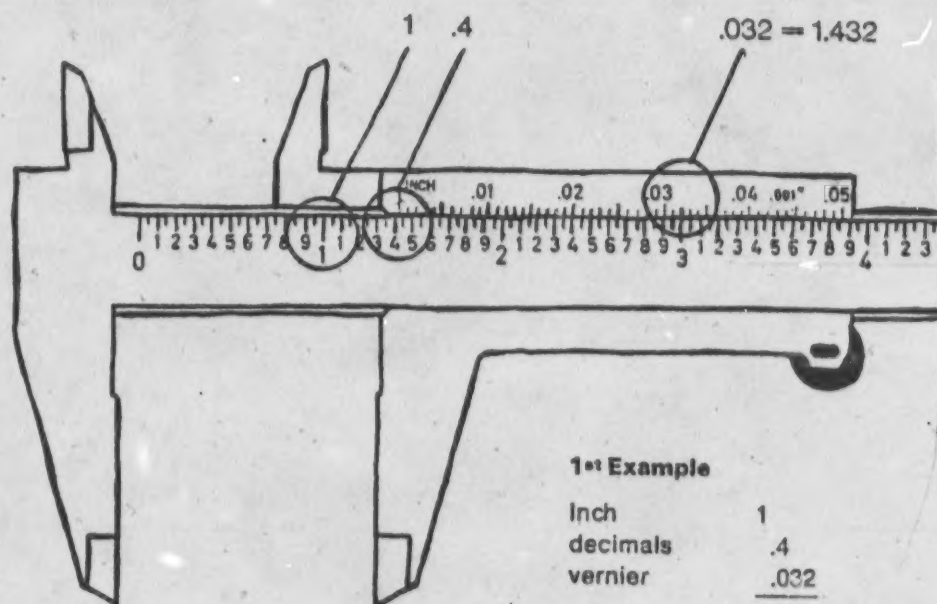
RVTC

PAGE 1 OF 4Explanation of Graduations

How to read the ".001" -- The reading of the decimal measurement in inches is taken with the "0" line of the slide and the upper scale of the beam which is graduated 20 divisions to the inch. The correct reading of ".001" occurs when a line on the vernier coincides with a line on the scale of the beam. If the "0" line of the vernier is over the half line between ".1" it is to add ".05" so .000 is to read as .050

.010	as .060
.020	as .070
.030	as .080
.040	as .090

Example No. 1



1st Example

Inch	1
decimals	.4
vernier	.032
	<u>1.432</u>

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	A	05	2

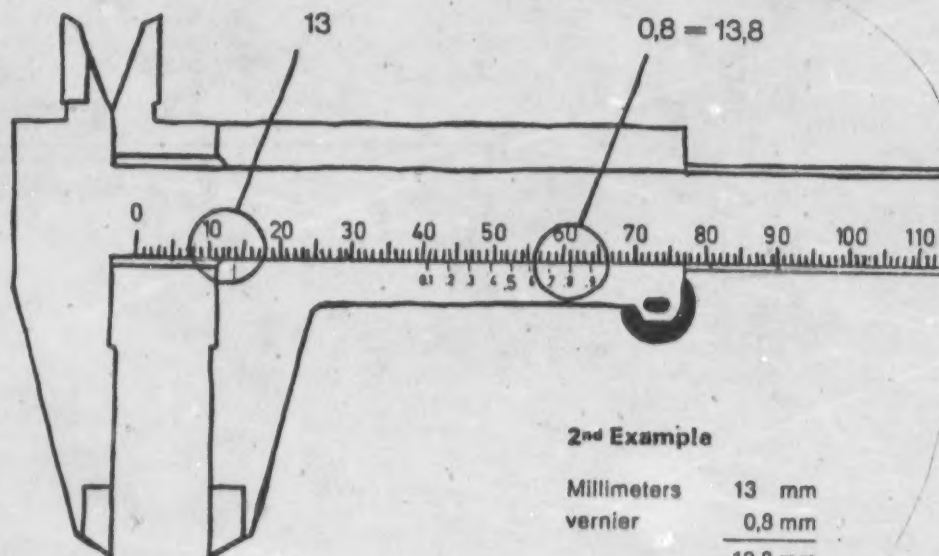
INSTRUCTION SHEET

RVTC

PAGE 2 OF 4

How to read the 0.1 mm -- The reading of the decimal measurement in millimeters is taken with the "0" line of the slide and the scale of the beam which is graduated in millimeters. The correct reading of 0.1 mm occurs when a line on the vernier coincides with a line on the scale of the beam.

Example 2



DEPT.	PROG.	DUTY	TASK	EN OBJ.
IN	9043	A	05	2

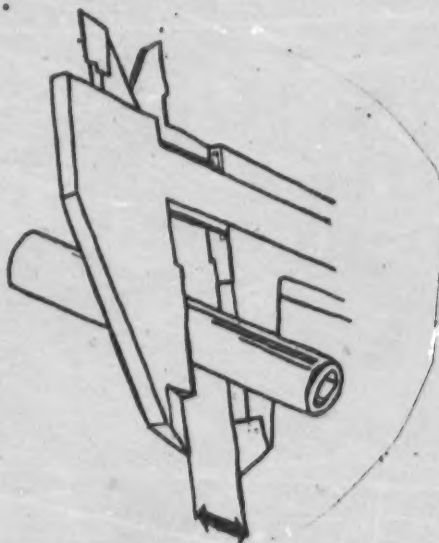
INSTRUCTION SHEET

RVTC

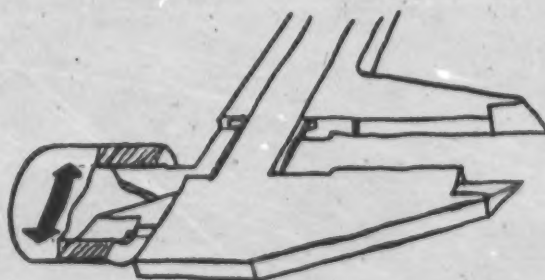
PAGE 3 OF 4

Examples of Applications

Outside measuring -- Measure with care and avoid any unnecessary pressure when measuring.



Inside measuring -- In this particular case it is extremely important to measure without pressure.



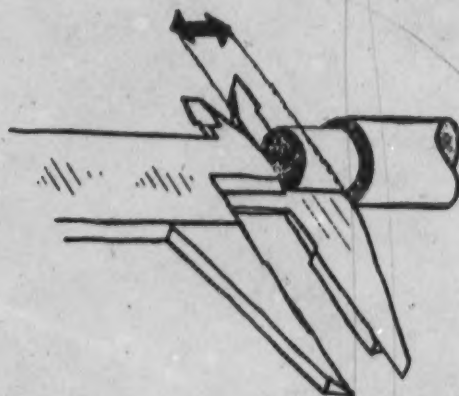
DEPT.	PROG.	DUTY	TASK	EN OBJ.
IN	9043	A	05	2

INSTRUCTION SHEET

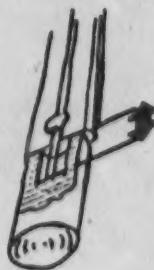
RVTC

PAGE 4 OF 4

Step measuring -- Do not use any pressure to avoid measuring errors.



Depth measuring -- Measure without pressure and apply only to the stop.



DEPT.	PROG	DUTY	TASK	EN OBJ.
IN	9043	A	05	2

ENABLING OBJECTIVE NO. 3

RVTC

Identify vernier caliper readings.

LEARNING STEPS

1. Read Resource No. 1 which describes the use of the vernier caliper.
2. Practice using a vernier caliper.
3. Before going on to the next Enabling Objective, check with your instructor.

RESOURCES

1. a. Text: Automotive Mechanics, pages 51 - 52.
- b. Text: Automotive Encyclopedia, pages 41 - 42.
2. a. Vernier caliper
- b. Measuring kit

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	A	05	3

ENABLING OBJECTIVE NO. 4

RVTC

Identify micrometer readings.

LEARNING STEPS

1. Read Resource No. 1 which describes the use of the micrometer.
2. Evaluate your knowledge by completing the Self-Check.
3. Practice measuring with a scale by completing Resource No. 3.
4. When you think you can perform this task, take the Performance Test.

RESOURCES

1. a. Text: Automotive Mechanics, pages 51 - 54.
b. Text: Automotive Encyclopedia, pages 39 - 42.
2. Self-Check enclosed.
3. a. Text: Automotive Mechanics, pages 49 - 54.
b. Text: Automotive Encyclopedia, pages 39 - 43.
4. Performance Test for task A-05.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	A	05	4

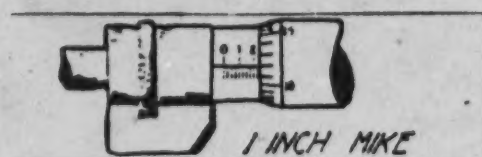
SELF-CHECK

RVTC

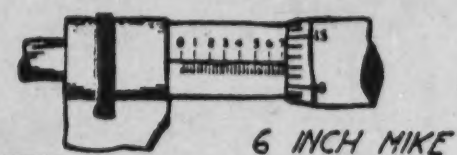
Directions

Evaluate your work by answering the items below. What are the readings of the following settings in thousandths.

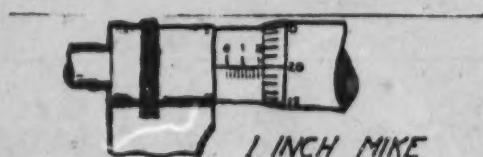
1.



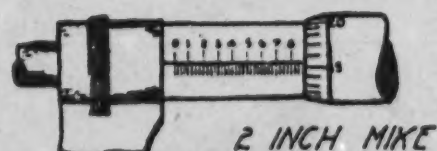
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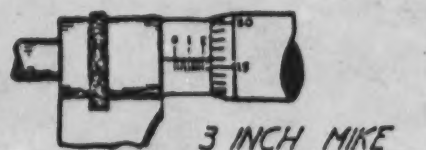
2.



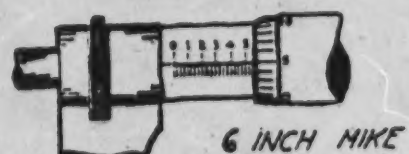
6.



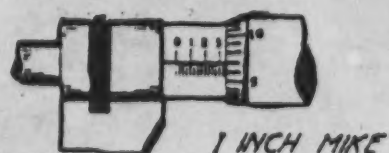
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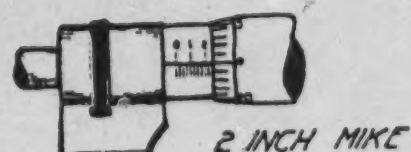
7.



4.



8.

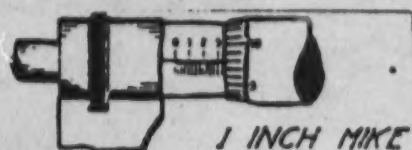


DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	05	4

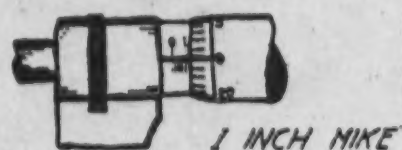
SELF-CHECK

RVTC

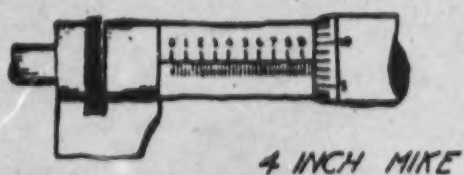
9.



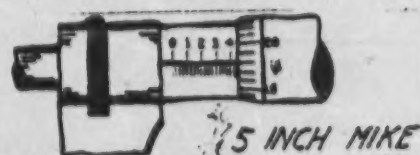
14.



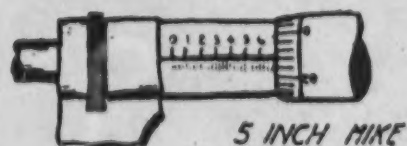
10.



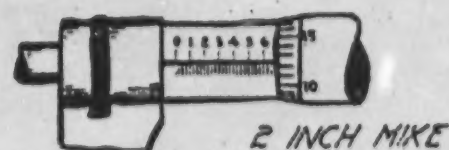
15.



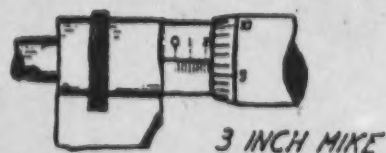
11.



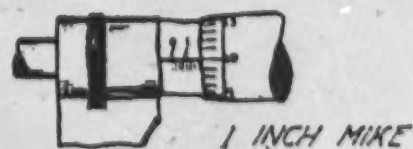
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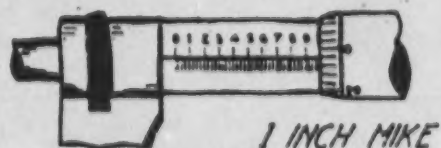
12.



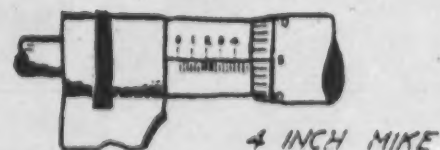
17.



13.



18.



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	05	4

SELF-CHECK

RVTC

Answer Key

1. .212
2. .220
3. 3.266
4. 1.327
5. 6.713
6. 2.890
7. 6.555
8. ✓ 2.250
9. 1.333
10. 4.958
11. 5.697
12. 3.232
13. 1.999
14. 1.125
15. 5.443
16. 2.563
17. 1.185
18. 2.563

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	05	4

PERFORMANCE TEST FOR TASK NO. A-05

RVTC

TASK:

Identify and Read Scales of Various Measuring Instruments

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will identify and read scales of various measuring instruments. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Was the vernier caliper selected and set to read 1.432 inches?		
2.	Was the measurement within .005?		
3.	Was the metric vernier caliper selected and set to read 13.8 mm?		
4.	Was the measurement within .005?		
5.	Was the outside micrometer (1 inch) selected and set to read .250?		
6.	Was the measurement within .005?		
7.	Was the inside micrometer selected and set to read .375?		
8.	Were the inside caliper and 2" outside micrometer selected?		
9.	Was the inside caliper set to read 2.215?		
10.	Was the measurement within .005?		
☐ ATTAINED ☐ NOT ATTAINED			
Score _____		EVALUATOR'S SIGNATURE _____	
DEPT.	PROG.	DUTY	TASK
IN	9043	A	05
		Page <u>1</u> of <u>1</u>	

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VO-TECH CENTER

7700 State Road 544 N

Winter Haven, Florida 33880

IN-9043-A-04

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Identify Fasteners, Grades and Bolts

DUTY:

Identifying Orientation Procedures

PURPOSE :

Being able to identify fasteners, bolts and grades is a very important part of a mechanic's job. Very seldom will a mechanic in an independent shop have a parts department available for his use. More often, a mechanic must request fasteners, grades and bolts. This Learning Guide will aid you in identifying fasteners, grades and bolts.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	A	04	

REVISED				

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:****GIVEN:** fasteners, bolts and grades,**YOU WILL:** identify fasteners, bolts and grades and their uses.**HOW WELL:** You must successfully complete the Written Test.
Your performance will be assessed by your instructor using the Performance Test on pages 8 and 9.**NOTE:**

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Identify fasteners, bolts and grades and their uses.

DEPT.	PROG.	DUTY	TASK
IN	9043	A	04

ENABLING OBJECTIVE NO. 1
RVTC

Identify fasteners, bolts and grades and their uses.

LEARNING STEPS

1. View Resource No. 1 to identify fasteners, bolts and grades.
2. Read Resource No. 2 to determine how fasteners, bolts and grades are used.
3. Evaluate your knowledge by completing the Self-Check.
4. When you think you can attain this task, take the Written Test.
5. When you successfully complete the Written Test, take the Performance Test.

RESOURCES

1. Hoffman slide/tape unit: 2.3.B.
2. Text: Crouse Automotive Mechanics, seventh edition, pages 23-27.
3. Self-Check enclosed.
4. Written Test for task A-04.
5. Performance Test for task A-04.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	A	04	1

SELF-CHECK

RVTC

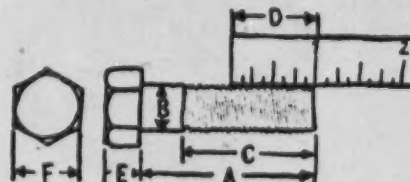
Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

- | | |
|--|-----------------|
| 1. screw that cuts its own threads. | a. head marking |
| 2. used to cut outside threads. | b. lock washer |
| 3. self-locking nut | c. die |
| 4. used to lock a castle nut | d. tap |
| 5. turning of a bolt or screw | e. heli-coil |
| 6. used to hold non-locking nuts | f. woodruff key |
| 7. used to cut inside threads | g. cotter key |
| 8. inserted to resize fouled threads | h. pal-nut |
| 9. fixtures on shafts that restrict movement | i. sheet metal |
| 10. indicate tensile strength of bolt | j. snap ring |
| | k. torqueing |

Evaluate your knowledge by matching the items in the drawing with the numbered items. Use a separate sheet of paper.

1. diameter
2. length
3. length of thread
4. pitch
5. size of wrench required for head



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	A	04	1

SELF-CHECK

RVTC

Answer Key

Matching questions

1. i
2. c
3. h
4. g
5. k
6. b
7. d
8. e
9. f
10. a

Matching questions

1. b
2. a
3. c
4. d
5. f

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	A	04	1

WRITTEN TEST FOR TASK NO. A-04

RVTC

IN-9043-A-04

TASK:

Identify Fasteners, Grades and Bolts

Directions

PAGE 1 OF 1

The purpose of this test is to determine if you fully understand how to identify fasteners, grades and bolts. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Matching. On the separate Answer Sheet, write the letter of the item that best identifies each statement.

DO NOT MARK ON THIS TEST!

Matching questions

1. bolt
2. stud
3. cap screw
4. flat rivet
5. countersunk rivet
6. oval rivet
7. internal lock washer
8. external lock washer
9. internal-external lock washer
10. cone point set-screw
11. cup point set-screw
12. flat point set-screw
13. oval point set-screw
14. castle nut
15. hex nut



DEPT.	PROG.	DUTY	TASK
IN	9043	A	04

P.

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WRITTEN TEST FOR TASK NO. A-04

RVTC

TASK:

Identify Fasteners, Grades and Bolts

ANSWER KEY

PAGE 1 OF 1

Multiple Choice questions

- | | | | | |
|----------------|-----------------|-----------------|-----------------|-----------------|
| <u> </u> 1. | <u> </u> 6. | <u> </u> 11. | <u> </u> 16. | <u> </u> 21. |
| <u> </u> 2. | <u> </u> 7. | <u> </u> 12. | <u> </u> 17. | <u> </u> 22. |
| <u> </u> 3. | <u> </u> 8. | <u> </u> 13. | <u> </u> 18. | <u> </u> 23. |
| <u> </u> 4. | <u> </u> 9. | <u> </u> 14. | <u> </u> 19. | <u> </u> 24. |
| <u> </u> 5. | <u> </u> 10. | <u> </u> 15. | <u> </u> 20. | <u> </u> 25. |

True-False questions

- | | | | | |
|--------|---------|---------|---------|---------|
| T F 1. | T F 6. | T F 11. | T F 16. | T F 21. |
| T F 2. | T F 7. | T F 12. | T F 17. | T F 22. |
| T F 3. | T F 8. | T F 13. | T F 18. | T F 23. |
| T F 4. | T F 9. | T F 14. | T F 19. | T F 24. |
| T F 5. | T F 10. | T F 15. | T F 20. | T F 25. |

Matching questions

- | | | | | |
|-------------|--------------|--------------|-----------------|-----------------|
| <u>c</u> 1. | <u>f</u> 6. | <u>g</u> 11. | <u> </u> 16. | <u> </u> 21. |
| <u>a</u> 2. | <u>d</u> 7. | <u>h</u> 12. | <u> </u> 17. | <u> </u> 22. |
| <u>l</u> 3. | <u>p</u> 8. | <u>n</u> 13. | <u> </u> 18. | <u> </u> 23. |
| <u>r</u> 4. | <u>j</u> 9. | <u>k</u> 14. | <u> </u> 19. | <u> </u> 24. |
| <u>e</u> 5. | <u>m</u> 10. | <u>o</u> 15. | <u> </u> 20. | <u> </u> 25. |

DEPT.	PROG.	DUTY	TASK
IN	9043	A	04

PERFORMANCE TEST FOR TASK NO. A-04

RVTC

IN-9043-A-04

TASK:

Identify Fasteners, Grades and Bolts

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will identify fasteners, grades and bolts. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO			
1.	Machine Screws a. Was hex head socket identified? b. Was flat blade identified? c. Was phillips head identified?					
2.	Sheet Metal Screws a. Was hex head screw identified? b. Was flat blade identified? c. Was phillips identified?					
3.	Flat Washers a. Was 1/4" identified? b. Was 5/16" identified? c. Was 3/8" identified?					
4.	Lock Washers a. Was 1/4" identified? b. Was 5/16" identified? c. Was 3/8" identified?					
☐ ATTAINED ☐ NOT ATTAINED Score _____ EVALUATOR'S SIGNATURE _____						
DEPT.	PROG.	DUTY	TASK	ATTEMPT	Page <u>1</u> of <u>2</u>	
IN	9043	A	04			

PERFORMANCE TEST FOR TASK NO. A-04

CONT.

IN-9043-A-04

ITEM NO.	ITEMS TO BE EVALUATED (CONT.):	YES	NO
5.	Star Lockwashers		
	a. Was 1/4" identified?		
	b. Was 5/16" identified?		
	c. Was 3/8" identified?		
6.	Were split pins identified?		
7.	Self-locking Nuts		
	a. Was 1/4" USS identified?		
	b. Was 5/16" USS identified?		
	c. Was 3/8" USS identified?		
	d. Was 1/4" SAE identified?		
	e. Was 5/16" SAE identified?		
	f. Was 3/8" SAE identified?		
8.	Castellated Nuts		
	a. Was 1/4" USS identified?		
	b. Was 5/16" USS identified?		
	c. Was 3/8" USS identified?		
	d. Was 1/4" SAE identified?		
	e. Was 5/16" SAE identified?		
	f. Was 3/8" SAE identified?		
PAGE <u>2</u> OF <u>2</u>			

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VO-TECH CENTER

7700 State Road 544 N
Winter Haven, Florida 33880

IN-9043-B-04

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Service Automatic Transmission

DUTY:

Performing Maintenance and Repairing Drive Train

PURPOSE :

An automatic transmission is a relatively complex component. It houses a large variety of moving parts and its major repair is not within the scope of tasks normally undertaken by the apprentice mechanic. Actually, a large percentage of transmission problems can be solved by on-the-car adjustment and repair.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	B	04	

REVISED				

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

GIVEN: shop vehicle and access to tools,

YOU WILL: service automatic transmission.

HOW WELL: Your performance will be assessed by your instructor using the Performance Test on pages 19-20.

NOTE:

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Test automatic transmission.
2. Service automatic transmission.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	04

ENABLING OBJECTIVE NO. 1
RVTC

Test automatic transmission.

LEARNING STEPS

1. View Resource No. 1 to identify the procedure for testing the automatic transmission.
2. Evaluate your knowledge by completing the Self-Check.
3. Using Resource No. 3, practice testing the automatic transmission.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. Hoffman slide/tape units: 4.2, 4.3, 4.6 and 4.7.
2. Self-Check enclosed.
3. Instruction Sheet enclosed, Procedure Sheet

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	04	1

SELF-CHECK**RVTC**Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. The viscosity index is an indication of:
 - a. how the fluid will look under normal conditions.
 - b. how the fluid will react under different conditions.
 - c. how the fluid will damage the engine if contaminated.
 - d. all of the above.
2. Fluid level should be checked:
 - a. when the fluid is at normal operating temperature.
 - b. when the fluid is cooler than it is at normal running speed.
 - c. only when the engine is not running.
 - d. none of the above.
3. Which item below should be performed before the road test?
 - a. disassemble the control circuit
 - b. adjust the linkage
 - c. check the oil level
 - d. all of the above
4. The underparts of the engine should be cleaned with:
 - a. acetone.
 - b. solvent.
 - c. transmission fluid.
 - d. motor oil.
5. Approximately how many minutes does it take the transmission fluid to reach normal operating temperature when the engine is running?
 - a. 20 minutes
 - b. 15 minutes
 - c. 10 minutes
 - d. 5 minutes
6. The normal rpm reading at full throttle should be about:
 - a. 1800 rpm.
 - b. 1500 rpm.
 - c. 1200 rpm.
 - d. 1000 rpm.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	04	1

SELF-CHECK**RVTC**

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. Changes in temperature change the viscosity of a fluid.
2. High viscosity means easy flow of the fluid.
3. Water or air in transmission fluid interferes with the operation of the system.
4. Noise resulting from the torque converter may produce a clunking sound.
5. A stall test can be performed on any transmission.

Now check your answers with the Answer Key.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	04	1

SELF-CHECK

RVTC

Answer Key

Multiple Choice

- 1. b
- 2. a
- 3. c
- 4. b
- 5. b
- 6. d

True-False

- 1. T
- 2. F
- 3. T
- 4. F
- 5. F

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	04	1

INSTRUCTION SHEET

7
RVTC

PAGE 1 OF 2

Procedure Sheet

STALL TEST

1. Bring engine to normal operating temperature.
2. Connect tachometer so it can be read from driver's seat.
3. Apply both parking and service brakes.
4. Place transmission in drive, and still holding brakes on, push accelerator to full throttle position.
5. Note rpm reading on tachometer.
6. Release full throttle position within five seconds and place transmission in neutral and operate engine at 1200 rpm for one to two minutes.
7. Repeat stall test procedure in different transmission drive range.
8. Take down rpm readings from tachometer for comparison with manufacturer's specifications.
9. Compare rpm readings with manufacturer's specifications.
10. Diagnose probable difficulty from results from stall test.

FLUID LEVEL CHECK

1. Bring fluid to normal operating temperature by driving or running at fast idle speed.
2. With car in level position, fluid temperature normal, engine at idle speed, shift lever in Neutral or Park, remove and wipe off dipstick cap and end of fill pipe.
3. Remove dipstick, wipe clean and reinsert in fill pipe.
4. Remove dipstick and observe fluid level.
5. If necessary, add correct fluid.
6. If necessary, drain off excess fluid.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	04	1

INSTRUCTION SHEET

RVTC

PAGE 2 OF 2

ROAD TESTING THE AUTOMATIC TRANSMISSION

1. Obtain automobile to be road tested and necessary forms.
2. Check oil level in automobile before testing.
3. Conduct road test, making notations as necessary.
4. Upon completion of road test, fill out transmission road test form specifying results of road test.

LEAKAGE CHECK

1. Position car on hoist properly.
2. Lift car and insert locking pin.
3. Clean underparts of engine with solvent and spray gun.
4. Blow underparts dry with air hose.
5. Bring transmission fluid to normal operating temperature.
6. Check the following for leaks: the extension housing seal, extension housing to transmission gasket, the oil pan gasket, front seal and converter, the shift lever shaft and the oil cooler line connections to the transmission case.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	04	1

ENABLING OBJECTIVE NO. 2

RVTC

Service automatic transmission.

LEARNING STEPS

1. View Resource No. 1 to identify the procedure for servicing the automatic transmission.
2. Evaluate your knowledge by completing the Self-Check.
3. Using Resource No. 3, practice servicing the automatic transmission.
4. When you think you can perform this task, take the Performance Test.

RESOURCES

1. a. Hoffman slide/tape units: 4.5, 4.8.A, 4.8.B and 4.8.C.
b. Text: Chilton's Auto Repair Manual, "Unit Repair Section -- Repair Automatic Transmission".
2. Self-Check enclosed.
3. Instruction Sheet enclosed, Procedure Sheet
4. Performance Test for task B-04.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	04	2

SELF-CHECK**RVTC**Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. On a vehicle with a Turbo-Hydra-Matic transmission, where is the linkage located?
 - a. under the hood
 - b. on the right side of the transmission and the frame
 - c. on the left side of the transmission and the frame
 - d. on the steering column
2. How many footpounds of torque should the shifter retaining nut be tightened on the floor shift transmission?
 - a. 30 - 35 foot pounds
 - b. 20 - 25 foot pounds
 - c. 15 - 20 foot pounds
 - d. 5 - 10 foot pounds
3. The first step in adjusting the shift cable on a pushbutton type transmission is to:
 - a. loosen the steering wheel from the steering column.
 - b. drain about two quarts of transmission fluid.
 - c. remove the control cable adjustment wheel.
 - d. remove the control clutch adjustment wheel.
4. When adjusting the bands on the Fordomatic two speed transmission the transmission fluid is drained:
 - a. before starting any adjustments.
 - b. after making the low band adjustment.
 - c. after making the rear band adjustment.
 - d. during any adjustments.
5. The heat exchanger is located:
 - a. in the bottom section of the carburetor.
 - b. in the distributor cap.
 - c. in the bottom section of the radiator.
 - d. in the water pump.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	04	2

SELF-CHECK**RVTC**

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. If kickdown does not occur a full throttle with the Turbo-Hydro-Matic; it will be necessary to replace the control switch.
2. If the oil screen is dacron, it should be washed, allowed to dry thoroughly and reinstalled.
3. Two quarts of transmission fluid should be drained before beginning to remove the extension housing.
4. Modulator repairs are possible and should be attempted since replacement can be expensive.

Now check your answers with the Answer Key.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	04	2

SELF-CHECK**RVTC**Answer KeyMultiple Choice

1. c
2. b
3. b
4. a
5. c

True-False

1. F
2. F
3. F
4. F

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	04	2

INSTRUCTION SHEET

RVTC

PAGE 1 OF 6Procedure Sheet

LINKAGE ADJUSTMENT

1. Obtain automobile and tools necessary for linkage adjustment procedures.
2. Have instructor evaluate your performance as you work.
3. To check proper operation of shift control linkage for Turbo-Hydra-Matic transmission, move shift lever until transmission is shifted into drive detent position.
4. Move control lever toward neutral without lifting it toward steering wheel.
5. Move control lever into low detent position.
6. Move lever toward reverse.
7. If linkage is incorrectly adjusted, place shift lever in "Drive" and raise car.
8. Loosen shift rod adjusting clamp bolt and remove rod from clamp.
9. Pull manual shift linkage as far to rear as possible.
10. Reinsert shift rod and move manual shift lever two clicks forward, placing transmission in "Drive" position.
11. Tighten adjusting rod bolt and linkage.
12. To check adjustment of shift linkage in floor-shift or console-type transmission select lever to drive position.
13. Raise vehicle and loosen manual lever control rod retaining nut.
14. Move transmission manual lever to drive position.
15. With transmission selector lever and manual lever in drive position, tighten retaining nut to 20 - 25 ft. lbs. torque.
16. Recheck operation of transmission in each selector lever position.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	04	2

INSTRUCTION SHEET

RVTC

PAGE 2 OF 6

17. To adjust the shift cable on a pushbutton type transmission, remove neutral starter switch and seal and drain two quarts of transmission fluid.
18. Have assistant hold button in reverse until transmission end of cable adjustment is complete.
19. Remove control cable adjustment wheel lock screw.
20. Back adjustment wheel off counterclockwise until only two or three threads are exposed behind wheel on housing.
21. Press control housing into case to bottom assembly.
22. Apply 2 to 3 lbs. of pressure against reverse detent while holding cable assembly centered in bore.
23. Rotate adjusting wheel to contact case.
24. Turn wheel clockwise just enough to make next adjustment hole in wheel line up with screw hole in case.
25. Count hole as number 1 and continue turning wheel until 5th hole lines up with screw hole on case.
26. Install lock screw and tighten to 30 - 50 inch lbs. torque.
27. Install neutral start switch and add fluid to transmission.
28. Check operation of pushbuttons to be sure they place vehicle into proper operations.
29. Check manufacturer's specifications for correct throttle linkage adjustment.
30. If transmission is not shifting correctly, have engine at normal operating temperature with carburetor off the fast idle cam.
31. With ignition turned off, disconnect throttle return spring.
32. Loosen throttle linkage adjustment locknut on throttle rod with a 7/16" socket.
33. Push throttle plate lever as far to rear as possible.
34. With other hand, push throttle rod back until it reaches its stop.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	04	2

INSTRUCTION SHEET

RVTC

PAGE 3 OF 6

35. Hold linkage in this position with one hand and use 7/16" socket in other hand to tighten linkage nut.
36. Reconnect throttle spring and adjustment is complete.

VACUUM LINE AND MODULATOR ON TURBO-HYDRO-MATIC TRANSMISSION REPLACEMENT

1. Remove vacuum hose at vacuum modulator.
2. Unscrew vacuum modulator from transmission.
3. Remove vacuum modulator from transmission case and remove valve.
4. If valve has nicks and/or scratches which cannot be repaired, it must be replaced.
5. To replace, insert vacuum modulator valve in bore in transmission.
6. Position "O" ring seal on vacuum modulator and reinstall unit.
7. Install vacuum hose from engine balance tube.

ADJUSTMENT OF NEUTRAL SAFETY SWITCH

1. Loosen mounting bolts on each side of switch.
2. Turn ignition switch to "start" position.
3. Place selector lever in neutral.
4. Rotate neutral safety switch in left-to-right direction until starter engages.
5. Turn ignition off and, while holding neutral safety switch in "start" position, retighten it.

CHECK FOR BACK-UP LIGHT SWITCH CIRCUIT

1. Place lever in reverse, check that back-up light is on; place lever in neutral, check that back-up light is out.
2. Place lever in drive; check that back-up light is off.
3. If light does not come on in reverse position, check if bulb is burned out and replace if necessary.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	04	2

INSTRUCTION SHEET

RVTC

PAGE 4 OF 6

4. If bulb okay, back-up light switch is defective and should be replaced.

ADJUSTMENT OF FORDOMATIC TWO-SPEED TRANSMISSION BANDS

1. Loosen low band adjustment locknut several turns.
2. Tighten adjusting screw until tool is felt and heard to click.
3. Back off adjusting screw two turns, hold this position and tighten locknut to 35 to 40 ft. lbs. torque.
4. Drain transmission fluid.
5. Loosen rear servo piston rod locknut and adjusting nut.
6. Position piston rod adjustment tool on rear servo piston rod so its slot straddles the band apply lever.
7. Back off piston rod locknut so wrench can engage adjusting nut.
8. Tighten adjusting nut with torque wrench until it clicks and overruns.
9. Use end wrench to back off adjusting nut two turns.
10. Pull tool away from servo rod about 1 inch.
11. Tighten locknut against adjusting nut to 15 to 18 ft. lbs. torque and remove tool from servo rod.
12. Remove and clean oil pan screen, then reinstall it.
13. Position new gasket on oil pan and install pan on transmission.
14. Refill transmission with fluid.

FLUID PAN REMOVAL, CONTROL VALVE BODY AND EXTENSION HOUSING REPLACEMENT

1. Raise vehicle on lift, observing all safety precautions.
2. Drain fluid from oil pan as it is removed.
3. Remove throttle valve lever and flat washer.
4. Remove oil screen.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	04	2

INSTRUCTION SHEET

RVTC

PAGE 5 OF 6

5. Remove attachment nut from adaptor stud at manual lever.
6. Remove adaptor.
7. Remove transfer plate bolts and remove valve assembly.
8. If valve body is damaged, replace it.
9. If oil screen is metal, clean before reinstalling. If dacron, replace.
10. Reinstall all parts by reversing above procedure.
11. To remove extension housing, remove speedometer drive pinion and sleeve assembly.
12. Drain two quarts of fluid from transmission.
13. Remove drive shaft.
14. Remove bolts which secure extension housing insulator to cross-member.
15. With jack, raise transmission slightly to clear crossmember and then remove crossmember.
16. On models with a parking lock lever, loosen parking brake cable clamp bolt where cable enters housing cover.
17. Remove housing cover lower plug with allen wrench.
18. Insert screwdriver through hole and withdraw brake cable.
19. Remove extension housing oil seal.
20. Remove transmission extension to case bolts and lock washers.
21. Loosen output shaft support assembly by tapping housing lightly with soft mallet.
22. Remove extension gasket.
23. To remove governor, first remove governor valve shaft snap ring from weight assembly end.
24. Remove governor valve shaft and valve.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	04	2

INSTRUCTION SHEET

RVTC

PAGE 6 OF 6

25. Remove large governor snap ring, and then governor weight assembly.
26. Remove retaining snap ring from governor.
27. Remove oil pump housing, gear and pinion and governor assembly from output shaft.
28. Mark face of pump gear in relation to pump housing for reassembly purposes.
29. To replace governor and extension housing, reverse above removal procedure.
30. Inspect motor mounts. If defective, replace and reinstall.

REPLACE - SOLENOID, DRAINING AND REFILLING CONVERTER AND PAN ADJUSTMENT OF ELECTRICAL CONTROL SWITCHES

1. To replace the kickdown solenoid assembly, disconnect solenoid lead from connector terminal.
2. Compress fingers on connector and remove connector and "O" ring seal.
3. Loosen and remove solenoid attaching screws and remove solenoid assembly and gasket.
4. To drain converter, remove drain plug by first removing inspection plate from transmission.
5. Turn converter until drain plug is visible.
6. Remove drain plug, drain, replace plug and refill transmission.
7. To adjust control switches, loosen locking screws on switch.
8. Place carburetor lever at full throttle stop and place .050 spacer between carburetor roller and switch plunger.
9. Advance switch body toward roller until plunger bottoms out.
10. Tighten and remove spacer.
11. Consult manufacturer's service manual for proper removal procedures for universal joint and drive shaft.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	04	2

PERFORMANCE TEST FOR TASK NO. B-04

RVTC

IN-9043-B-04

TASK:

Service Automatic Transmission

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will service an automatic transmission. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Were safety glasses worn?		
2.	Was fluid brought to a normal operating temperature before checking?		
3.	Was dip stick removed and reinserted?		
4.	Was diagnosis made whether to add or drain fluid?		
5.	Was oil level checked before road test?		
6.	Was vehicle road tested according to instructions?		
7.	Was road test form completed?		
8.	Were all underparts of the engine cleaned?		
9.	Was extension housing seal checked?		
10.	Was extension housing to transmission gasket checked?		
11.	Was oil pan gasket checked?		
12.	Were front seal and converter checked?		
13.	Was shift lever shaft checked?		
14.	Were oil cooler lines checked?		
15.	Were stall test difficulties diagnosed?		
16.	Was shift control linkage for Turbo-Hydra-Matic transmission checked?		
☐ ATTAINED ☐ NOT ATTAINED			
Score _____		EVALUATOR'S SIGNATURE _____	
DEPT.	PROG.	DUTY	TASK
IN	9043	B	04
Page 1 of 2			

PERFORMANCE TEST FOR TASK NO. B-04

CONT.

IN-9043-B-04

ITEM NO.	ITEMS TO BE EVALUATED (CONT.):	YES	NO
17.	Was shift linkage in floor shift type transmission checked?		
18.	Was shift cable adjustment on pushbutton type transmission checked?		
19.	Was the throttle linkage adjusted?		
20.	Was vacuum modulator replaced?		
21.	Was vacuum modulator valve replaced?		
22.	Was neutral safety switch adjusted?		
23.	Were Fordomatic bands adjusted?		
24.	Was the heat exchanger flow tested?		
25.	Were kickdown and converter pitch solenoid replaced?		
26.	Were converter and pan drained and refilled?		
27.	Was the electrical control switch adjusted?		
PAGE <u>2</u> OF <u>2</u>			

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IN-9043-B-05

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Perform Chassis Maintenance and Inspection

DUTY:

Performing Maintenance and Repair on Drive Train

PURPOSE :

The chassis lubrication and maintenance inspection is one of the most common tasks in the automotive field and one of the most neglected. Preventive maintenance can save costly repairs and prolong vehicle life. This Learning Guide will aid you in performing the service necessary to keep a vehicle in safe running condition.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	B	05	

REVISED :

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

GIVEN: the necessary tools, materials and a vehicle,

YOU WILL: perform a chassis lubrication and maintenance inspection.

HOW WELL: Your performance will be assessed by your instructor using the Performance Test on page 10.

ENABLING OBJECTIVES:

1. Describe the procedure for performing a chassis lubrication and maintenance inspection.
2. Perform a chassis lubrication and maintenance inspection.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	05

ENABLING OBJECTIVE NO. 1

RVTC

Describe the procedure for performing a chassis lubrication and maintenance inspection.

LEARNING STEPS

1. Read Resource No. 1 to become familiar with the procedure for performing chassis lubrication and maintenance inspection.
2. Evaluate your knowledge by completing the Self-Check.
3. Go on to Enabling Objective No. 2.

RESOURCES

1. Instruction sheet enclosed, Chassis Lubrication and Maintenance Inspection.
2. Self-check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	05	1

INSTRUCTION SHEET

RVTC

PAGE 1 OF 3

Chassis Lubrication and Maintenance Inspection

STEP I

- A. Move vehicle into service area over lift.
- B. Before leaving driver's seat, turn engine off. Check all lights, outside and inside vehicle. Some lights, such as dash warning lights, require the ignition switch to be on. If this is the case with the vehicle being tested turn the ignition switch on but DO NOT start the engine.
- C. Check brake pedal free play, if the brake is low, make a note of it to be brought to the customer's attention.
- D. Unlock all doors and pull the hood latch release.
- E. Check operation of horn.
- F. Check operation of windshield wipers and washers.
- G. Check operation of seat track adjustment.
- H. Check operation of heater fan and air-conditioning fan.
- I. Check operation of turn signal switch.
- J. Check operation of window cranks or operators.
- K. Check for free play in steering which could mean worn or damaged parts. Make a list on the back of the repair order of all items which are in need of repair. At this point you are ready to leave the driver's seat.

STEP II. Position the lift under the vehicle in a proper lift point, (on frame of vehicle). Raise the vehicle off the floor about three (3") inches and check lift pads. Make sure vehicle is on the lift pads in a solid position. At this point you are ready for the next check. Raise the hood and check the following items.

- A. Check air filter for dirt or other obstructions.
- B. Check belts for cracks, wear and proper tension.
- C. Check radiator hoses for cracks, leaks or wear.
- D. Check heater hoses for cracks, leaks or wear.
- E. Check for leaks, oil, gasoline or water.
- F. Check the following fluid levels:
 1. battery water and cable condition
 2. radiator water
 3. washer water

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	05	1

INSTRUCTION SHEET

RVTC

PAGE 2 OF 3

4. engine oil level -- (if not changing oil)
5. brake fluid level
6. power steering fluid level

Make a note of any repairs needed as you find them.

STEP III. Raise the vehicle to approximately three feet off the floor and check the following items.

- A. Air pressure in tires (as per manufacturer's specifications)
- B. Lubricate all latches with lubricant such as lubriplate or white grease.
- C. Oil all hinges, hood, doors and trunk.
- D. Lubricate lock cylinders with light lubricant (W-D-40 or lock lubricant)

STEP IV. Raise vehicle to overhead position and complete the following items:

- A. Drain engine oil into drain tank (if changing oil)
- B. Check transmission fluid (if standard shift)
- C. Check fluid level in rear end.
- D. Clean and lubricate all fittings with chassis lube.
- E. Remove oil filter and install a new one (if changing oil)

STEP V. Look for worn or damaged parts. The experienced mechanic will develop a trained eye and can spot worn or damaged parts under a vehicle in a few moments. Inspect the following items:

- A. Steering components
- B. Suspension parts (front end)
- C. Check for leaks on engine and transmission
- D. Check exhaust system
- E. Check universals and driveshaft for excess wear or free play
- F. Check all tires for un-even wear or damage
- G. Check for loose wheel bearings
- H. Check for leaking wheel seals or leaking brake fluid

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	05	1

INSTRUCTION SHEET

RVTC

PAGE 3 OF 3

Remember: Any damaged part you find now can prevent a breakdown later.
Make note of all items to be repaired.

STEP VI. Install the drain plug for engine oil. Remove the drain pan and lower vehicle to floor to complete the following items.

- A. Fill Engine With Proper Oil to Full Mark as per manufacturer's specifications.
- B. Wipe off any excess oil or grease. Remove any loose parts, tools, rags, etc. on or near the engine that could prevent starting.
- C. Start engine and watch for oil light to go out, if light does not go out in approximately five seconds, shut off the engine and re-check oil level. This is to prevent damage to the engine from lack of oil.
- D. Check transmission fluid level (if automatic) use information on transmission dip stick.
- E. Install lubrication sticker with proper mileage, oil used and the date of today recorded on it.
- F. Re-check for leaks on filter and under engine.
- G. Remove vehicle lift pads.
- H. Contact instructor, service manager or customer with list of items in need of repair.

Remember: Each damaged item you find now will save the customer time and money later on. You, the mechanic, have a trained eye and should be able to spot problems readily. Check the vehicle thoroughly for the customer.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	05	1

SELF-CHECK**RVTC**Directions

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. There are eight fluid levels to check on a lubrication and maintenance inspection.
2. At least ten items on the lubrication and maintenance checklist can be done without leaving the driver's seat.
3. You should check only the items the customer asks you to check.
4. Lubrication and maintenance is the number one reason for good or poor vehicle service.
5. Checking for worn or damaged shocks is not part of this inspection.
6. Any repairs should be done as the inspection is conducted.
7. A thorough lubrication and maintenance inspection should take one hour.
8. There are only two water levels to check: battery and radiator on this inspection.
9. If the oil light does not go out after the engine is started, wait one minute and then shut the engine off.
10. It is the customer's responsibility to keep up with worn or damaged parts on his vehicle, not the mechanics.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	05	1

SELF-CHECK

RVTC

Answer Key

1. T
2. T
3. F
4. T
5. F
6. F
7. F
8. F
9. F
10. F

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	05	1

ENABLING OBJECTIVE NO. 2

RVTC

Perform a chassis lubrication and maintenance inspection.

LEARNING STEPS

1. Review Resource No. 1 in Enabling Objective No. 1, to prepare to do a chassis lubrication and maintenance inspection
2. Practice performing a chassis lubrication and maintenance inspection on a vehicle.
Have instructor evaluate.
3. When you think you can perform this task, take the Performance Test.

RESOURCES

1. Instruction Sheet enclosed, Chassis Lubrication and Maintenance Inspection from Enabling Objective No. 1.
2. Vehicle
3. Performance Test for task B-05.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	05	2

PERFORMANCE TEST FOR TASK NO. B-05

RVTC

IN-9043-B-05

TASK:

Perform Chassis Lubrication and Maintenance Inspection

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will perform a chassis lubrication and maintenance inspection. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
		1.	Was vehicle placed securely on lift?
2.	Were lights checked before student left driver's seat?		
3.	Were brakes and turn signals checked?		
4.	Was steering checked for free play?		
5.	Were doors, hood and trunk hinges lubricated?		
6.	Were belts and hoses checked?		
7.	Was vehicle checked for worn or damaged parts while on the lift?		
8.	Were fittings cleaned and lubricated?		
9.	Was oil put in engine?		
10.	Was customer or instructor informed of needed repairs?		

Score _____
☐ ATTAINED
☐ NOT ATTAINED

EVALUATOR'S SIGNATURE _____

DEPT.	PROG.	DUTY	TASK	ATTEMPT
IN	9043	B	05	

Page 1 of 1

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IN-9043-B-06

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Repair Exhaust System

DUTY:

Performing Maintenance and Repair on Drive Train

PURPOSE :

This task is basic to automotive repair. It is important for you to identify the process of inspecting exhaust systems. The inspections will determine what repairs are needed and you will be taught how to remove and replace worn parts. This Learning Guide is designed to identify these steps and make you a competent mechanic.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	B	06	

REVISED				

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

GIVEN: tools, work station and a shop vehicle,

YOU WILL: inspect and repair an exhaust system.

HOW WELL: You must successfully complete the Written Test.
Your performance will be assessed by your instructor using the Performance Test on page 24.

ENABLING OBJECTIVES:

1. Define the types of exhaust systems and their components.
2. Identify the steps in inspecting the exhaust system.
3. Remove and replace the parts of the exhaust system.
4. Identify the procedure for removal, inspection and servicing of the catalytic converter.
5. Inspect and repair exhaust system.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	06

ENABLING OBJECTIVE NO. 1

RVTC

Define the types of exhaust systems and their components.

LEARNING STEPS

1. Read Resource No. 1 to identify the types of exhaust systems.
2. View Resource No. 2 showing a typical exhaust system.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. Text: Introduction to Automotive Mechanics, Unit 4-- "Types of Exhaust Systems", pages 14 - 15.
2. Shop engine display -- #1 Red engine stand, 350 CDI--single exhaust with catalytic converter.
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	06	1

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by identifying the items on the illustration below using a separate sheet of paper.

Figure 1 Single Exhaust System

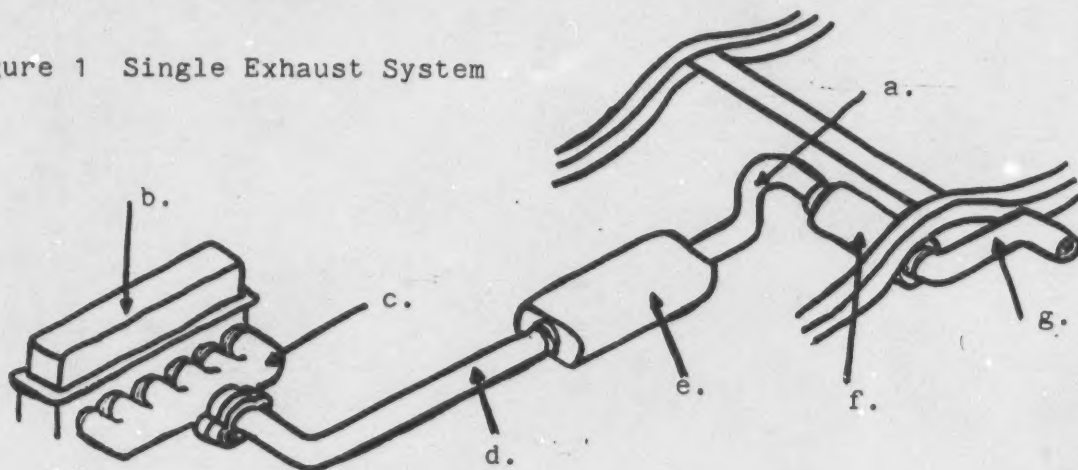
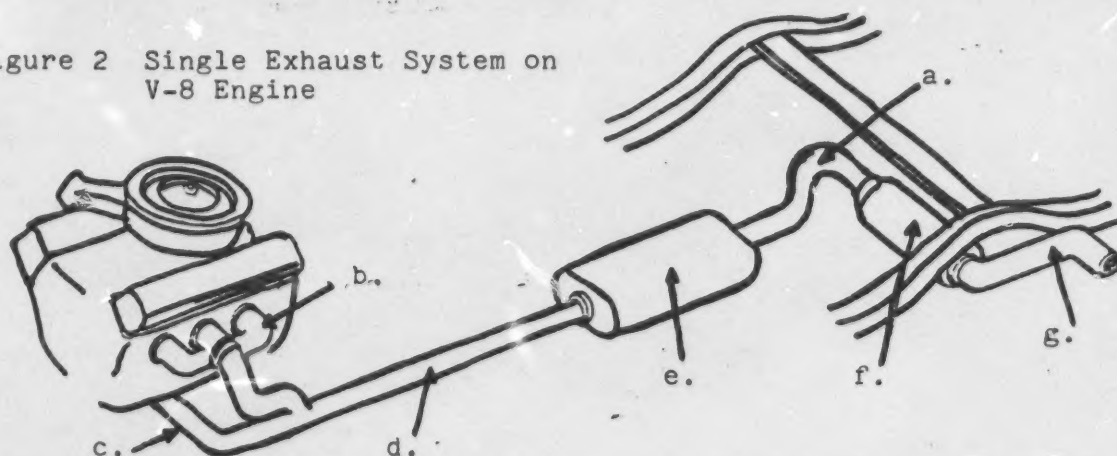


Figure 2 Single Exhaust System on V-8 Engine



DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	06	1

SELF-CHECK

RVTC

Figure 3 Dual Exhaust System

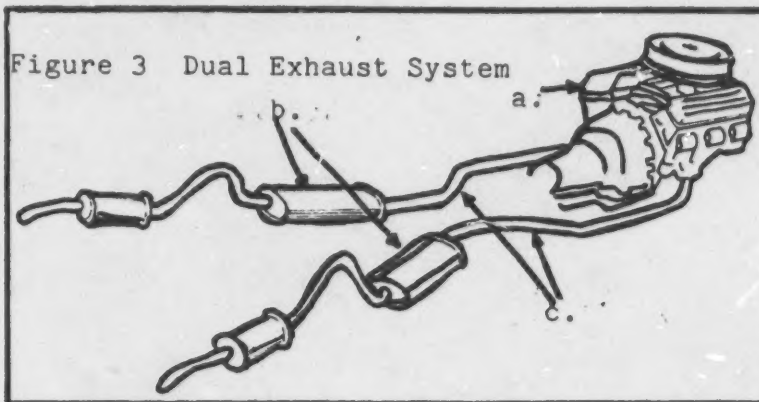
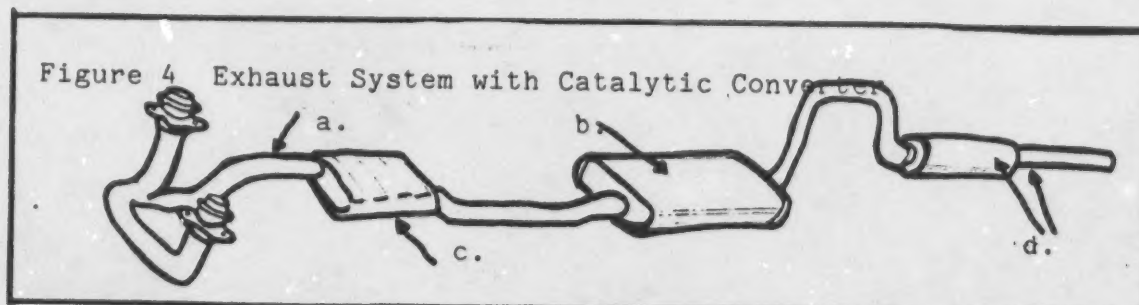


Figure 4 Exhaust System with Catalytic Converter



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	06	1

SELF-CHECK

RVTC

Answer Key

Figure 1

- a. -- intermediate pipe
- b. -- six-cylinder engine
- c. -- exhaust manifold
- d. -- exhaust pipe
- e. -- muffler
- f. -- resonator
- g. -- tail pipe

Figure 2

- a. -- intermediate pipe
- b. -- exhaust manifold
- c. -- crossover pipe
- d. -- exhaust pipe
- e. -- muffler
- f. -- resonator
- g. -- tail pipe

Figure 3

- a. -- V-8 engine
- b. -- muffler
- c. -- exhaust pipes

Figure 4

- a. -- exhaust pipe
- b. -- muffler
- c. -- catalytic converter assembly
- d. -- tail pipe and resonator

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	06	1

ENABLING OBJECTIVE NO. 2

7
RVTC

Identify the steps in inspecting the exhaust system.

LEARNING STEPS

1. Read Resource No. 1 to identify the procedure for inspecting the exhaust system.
2. Evaluate your knowledge by completing the Self-Check.
3. Go on to Enabling Objective No. 3.

RESOURCES

1. Text: Introduction to Automotive Mechanics, Unit 4--
"Inspection of Exhaust System"
pages 15 - 18.
2. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	06	2

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. Which safety procedures should not be observed when inspecting the exhaust system?
 - a. always wear eye protection
 - b. wear a short sleeved shirt
 - c. wear gloves
 - d. wear safety-toe shoes
 - e. use the exhaust ventilation system when running an engine inside a closed area
2. Which safety procedures should not be observed when using lifting equipment?
 - a. when raising a vehicle with a jack, raise it slowly
 - b. always support the vehicle by placing jack stands under the proper vehicle lift points
 - c. always leave the jack handle in the down position (parallel to the floor)
 - d. always check to be sure that the vehicle is securely on a lift or jack before raising it
3. Which exhaust system is most common?
 - a. dual exhaust system
 - b. single exhaust system
 - c. triple exhaust system
 - d. combination exhaust system
4. Four and six cylinder vehicles usually have a/an:
 - a. dual exhaust.
 - b. single exhaust.
 - c. either a or b.
 - d. neither a nor b.
5. Eight cylinder vehicles can have a/an:
 - a. dual exhaust.
 - b. single exhaust.
 - c. either a or b.
 - d. neither a nor b.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	06	2

SELF-CHECK**RVTC**

6. What is the purpose of the catalytic converter?
- a. to lower the emission levels of harmful exhaust gases.
 - b. to make the vehicle use less gas.
 - c. to reduce corrosion of the exhaust system.
 - d. to make the engine run smoother.
7. Mechanic A says that you should have a vehicle running before you lift it to inspect the exhaust system for leaks. Mechanic B disagrees. He says that you should never left a vehicle that is running. Who is right?
- a. A only
 - b. B only
 - c. both A and B
 - d. neither A nor B.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	06	2

SELF-CHECK

RVTC

Answer Key

1. b
2. c
3. b
4. b
5. c
6. a
7. a

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	06	2

ENABLING OBJECTIVE NO. 3

RVTC

Remove and replace the parts of the exhaust system.

LEARNING STEPS

1. Read Resource No. 1 to identify the steps in replacing the tail pipe.
2. Read Resource No. 2 to identify the steps used in replacing the muffler.
3. Read Resource No. 3 to identify the steps used in replacing the exhaust pipe.
4. Evaluate your knowledge by completing the Self-Check.
5. Go on to Enabling Objective No. 4.

RESOURCES

1. Text: Introduction to Automotive Mechanics, Unit 4-- "Removing and Replacing the Tail Pipe", pages 22 - 30.
2. Text: Introduction to Automotive Mechanics, Unit 4-- "Replacing the Muffler", pages 35 - 36.
3. Text: Introduction to Automotive Mechanics, Unit 4-- "Removing and Replacing the Exhaust Pipe", pages 39 - 41.
4. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	06	3

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. Before replacing a tail pipe, you should lift the vehicle so that the rear wheels drop. This gives you more working clearance. To do this, you must lift on the vehicle's:
 - a. rear axle.
 - b. rear wheels.
 - c. frame or bumper.
 - d. rear-end housing.
2. If a muffler is worn out, you should loosen the exhaust pipe from the muffler neck by:
 - a. splitting the muffler neck with an air chisel.
 - b. heating the muffler neck and twisting the tail pipe.
 - c. cutting off the tail pipe.
 - d. cutting off the neck of the muffler.
3. Before a replacement tail pipe is installed, the muffler neck must be:
 - a. cut off.
 - b. heated.
 - c. replaced.
 - d. expanded.
4. After checking the exhaust system for leaks, you should:
 - a. check the car for rattles by bumping the exhaust system.
 - b. deliver the car to the customer.
 - c. return the car to the parking lot.
 - d. re-check all hangers and clamp bolts.
5. When removing a defective muffler, you should first:
 - a. split the muffler neck.
 - b. remove the clamps from both ends of the muffler.
 - c. heat the muffler neck.
 - d. split the tail pipe.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	06	3

SELF-CHECK

RVTC

6. On the front of the muffler, the neck of the muffler always fits:
 - a. over the exhaust pipe.
 - b. inside the exhaust pipe.
 - c. over the tail pipe.
 - d. inside the tail pipe.
7. When a defective muffler is being removed, the front neck of the muffler should always be:
 - a. heated with a torch.
 - b. split with a cutting torch.
 - c. cut off.
 - d. loosened with a hammer first.
8. Before unscrewing the flange nuts on the exhaust manifold end of the exhaust pipe, you should:
 - a. apply penetrating oil to the nuts.
 - b. split the nuts with an air chisel.
 - c. hammer on the nuts to loosen them.
 - d. apply heat to the nuts.
9. If you accidentally twist off the exhaust manifold studs, you will have to:
 - a. drill the studs and remove them with an easy out.
 - b. get a new exhaust manifold.
 - c. get a new exhaust pipe.
 - d. remove the manifold to complete the repairs.
10. The flange nuts holding the exhaust pipe flange to the exhaust manifold should be tightened:
 - a. one at a time.
 - b. alternately (tighten first one a little, then the other one a little).
 - c. to 15 foot pounds of torque.
 - d. to 50 foot pounds of torque.

Now check your answer with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	06	3

SELF-CHECK

RVTC

Answer Key

1. c
2. b
3. b
4. a
5. b
6. a
7. b
8. a
9. a
10. b
11. d

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	06	3

ENABLING OBJECTIVE NO. 4

RVTC

Identify the procedure for removal, inspection and servicing of the catalytic converter.

LEARNING STEPS

1. Read Resource No. 1 to identify the various types of catalytic converters.
2. Read Resource No. 2 to identify the steps used in removing and replacing a catalytic converter.
3. Read Resource No. 3 to identify the steps in servicing a catalytic converter.
4. Evaluate your knowledge by completing the Self-Check.
5. When you think you can attain this task, take the Written Test.
6. Go on to Enabling Objective No. 5.

RESOURCES

1. Text: Introduction to Automotive Mechanics, Unit 4--
"Types of Catalytic Converters", pages 51 - 53.
2. Text: Introduction to Automotive Mechanics, Unit 4--
"Removing and Replacing a Catalytic Converter", pages 53-
pages 53 - 54.
3. Text: Introduction to Automotive Mechanics, Unit 4--
"Replacing the Catalyst Pellets in a Converter", pages 57 - 60.
4. Self-Check enclosed.
5. Written Test for task B-06.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9205	B	06	4

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. The monolithic core converter is found on:
 - a. Ford vehicles only.
 - b. Chrysler vehicles only.
 - c. General Motors vehicles only.
 - d. Ford and Chrysler vehicles.
2. The purpose of a catalyst is to:
 - a. lower emissions by reducing the heat of exhaust gases.
 - b. promote the burning of exhaust gases to lower emissions.
 - c. decrease the amount of carbon buildup on spark plugs.
 - d. lower the noise of exhaust gases going through the muffler.
3. Which type of converter cannot be serviced?
 - a. monolithic core
 - b. pellet-filled
 - c. both monolithic and pellet-filled
 - d. Ford type only
4. The first thing you must remove to get to the converter on a Chrysler vehicle is the:
 - a. tail pipe.
 - b. muffler.
 - c. heat shield.
 - d. exhaust pipe hanger.
5. If the converter has a pressed plug, you must remove it with a:
 - a. 3/4 inch hex wrench.
 - b. socket set.
 - c. chisel and pliers.
 - d. portable drill and drill bit.
6. The purpose of the aspirator is to:
 - a. remove all exhaust gases while the pellets are being replaced.
 - b. hold the pellets in place while the fill plug is being removed.
 - c. shake the pellets out of the converter.
 - d. none of the above.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	06	4

SELF-CHECK

RVTC

7. If a converter is built with a pressed plug, you must:
 - a. repair the old pressed plug you removed.
 - b. install a service fill plug.
 - c. weld the plug back into the converter.
 - d. rethread the pressed plug hole.

8. A threaded fill plug should be torqued to:
 - a. 30 ft.-lbs.
 - b. 45 ft.-lbs.
 - c. 60 ft.-lbs.
 - d. 75 ft.-lbs.

9. A service fill plug should be torqued to:
 - a. 20 ft.-lbs.
 - b. 24 ft.-lbs.
 - c. 28 ft.-lbs.
 - d. 32 ft.-lbs.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. CBJ.
IN	9043	B	06	4

SELF-CHECK

RVTC

Answer Key

1. d
2. b
3. a
4. c
5. c
6. b
7. b
8. c
9. c

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	06	4

WRITTEN TEST FOR TASK NO. B-06

RVTC

TASK: Repair Exhaust System

IN-9043-B-06

DirectionsPAGE 1 OF 3

The purpose of this test is to determine if you fully understand how to repair an exhaust system. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Multiple Choice. On the separate Answer Sheet, put the letter of the correct answer in the blank to the left of the number of the question.

DO NOT MARK ON THIS TEST!

Multiple Choice questions

1. When working under a vehicle, you should always:
 - a. wear short sleeves.
 - b. wear eye protection.
 - c. use the exhaust ventilation system.
 - d. have the engine running.
2. Four and six cylinder vehicles usually have what type of exhaust system?
 - a. dual exhaust
 - b. single exhaust
 - c. one piece muffler and tail pipe
 - d. exhaust headers
3. A kink in the tail pipe of a vehicle will:
 - a. stop the flow of exhaust gases.
 - b. restrict the flow of exhaust gases.
 - c. blow up the engine.
 - d. melt the resonator.
4. When you connect the exhaust pipe to the exhaust manifold, you must use:
 - a. a sealer and U-bolts.
 - b. a welder to weld the joints.
 - c. a gasket, nuts and studs.
 - d. none of the above.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	06

WRITTEN TEST FOR TASK NO. B-06

RVTC

TASK:

Repair Exhaust System

PAGE 2 OF 3

5. Muffler clamps are also called:
 - a. exhaust pipe straps.
 - b. U-bolt clamps.
 - c. aviation clamps.
 - d. slot-screw clamps.
6. A single exhaust system on a V-8 engine uses what type of exhaust pipe to connect to the manifold?
 - a. intermediate pipe
 - b. crossover pipe
 - c. tail pipe
 - d. single exhaust pipe
7. Before you begin to work on replacing a tail pipe, you must use an extension jack to support the:
 - a. muffler.
 - b. tail pipe.
 - c. exhaust pipe.
 - d. catalytic converter.
8. If the muffler is to be replaced, you should loosen the exhaust pipe from the muffler neck by:
 - a. splitting the muffler neck with an air chisel.
 - b. heating the muffler neck and twisting the tail pipe.
 - c. cutting off the tail pipe.
 - d. striking the connection with a hammer.
9. On the rear of the muffler, the neck of the muffler always fits:
 - a. over the tail pipe.
 - b. inside the tail pipe.
 - c. over the exhaust pipe.
 - d. inside the exhaust pipe.
10. How far from the end of the neck of the muffler should the muffler clamp be positioned?
 - a. 3 inches
 - b. 2 inches
 - c. 1/2 inch
 - d. 1/8 inch

DEPT.	PROG.	DUTY	TASK
IN	9043	B	06

WRITTEN TEST FOR TASK NO. B-06

RVTC

TASK: Repair Exhaust System

PAGE 3 OF 3

11. If the tail pipe will not come loose from the muffler easily, what tool should you use to loosen it?
- hammer and chisel
 - heat clamp
 - oxyacetylene torch
 - hacksaw

The items below are True-False. On the separate Answer Sheet, circle T if the item is True and F if the item is False.

DO NOT MARK ON THIS TEST!

True-False questions

- Muffler clamps (U-bolts) should always be replaced when replacing exhaust system parts.
- When removing mufflers and tail pipes, you may have to split the muffler or tail pipe.
- You cannot use a chisel to cut a pipe away from the muffler.
- A pipe expander can be used to round a tail pipe back to its original shape.
- You should always measure the length of the muffler neck before inserting the tail pipe into it.
- When raising a vehicle with a jack, raise it slowly.
- You should support the vehicle by placing jack stands under the proper vehicle lift points.
- You should leave the jack handle in the down (parallel to the floor) position.
- You should check to be sure that the vehicle is securely on a lift or jack before raising it.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	06

IN-9043-B-06

WRITTEN TEST FOR TASK NO. B-06

RVTC

TASK:

Repair Exhaust System

ANSWER KEY

PAGE 1 OF 1Multiple Choice questions

- | | | | | |
|-------------|--------------|-----------------|-----------------|-----------------|
| <u>b</u> 1. | <u>b</u> 6. | <u>b</u> 11. | <u> </u> 16. | <u> </u> 21. |
| <u>b</u> 2. | <u>a</u> 7. | <u> </u> 12. | <u> </u> 17. | <u> </u> 22. |
| <u>b</u> 3. | <u>a</u> 8. | <u> </u> 13. | <u> </u> 18. | <u> </u> 23. |
| <u>c</u> 4. | <u>a</u> 9. | <u> </u> 14. | <u> </u> 19. | <u> </u> 24. |
| <u>b</u> 5. | <u>d</u> 10. | <u> </u> 15. | <u> </u> 20. | <u> </u> 25. |

True-False questions

- | | | | | |
|----------|----------|---------|---------|---------|
| (T) F 1. | (T) F 6. | T F 11. | T F 16. | T F 21. |
| (T) F 2. | (T) F 7. | T F 12. | T F 17. | T F 22. |
| T (F) 3. | T (F) 8. | T F 13. | T F 18. | T F 23. |
| (T) F 4. | (T) F 9. | T F 14. | T F 19. | T F 24. |
| (T) F 5. | T F 10. | T F 15. | T F 20. | T F 25. |

Matching questions

- | | | | | |
|----------------|-----------------|-----------------|-----------------|-----------------|
| <u> </u> 1. | <u> </u> 6. | <u> </u> 11. | <u> </u> 16. | <u> </u> 21. |
| <u> </u> 2. | <u> </u> 7. | <u> </u> 12. | <u> </u> 17. | <u> </u> 22. |
| <u> </u> 3. | <u> </u> 8. | <u> </u> 13. | <u> </u> 18. | <u> </u> 23. |
| <u> </u> 4. | <u> </u> 9. | <u> </u> 14. | <u> </u> 19. | <u> </u> 24. |
| <u> </u> 5. | <u> </u> 10. | <u> </u> 15. | <u> </u> 20. | <u> </u> 25. |

DEPT.	PROG.	DUTY	TASK
IN	9043	B	06

ENABLING OBJECTIVE NO. 5

RVTC

Inspect and repair exhaust system.

LEARNING STEPS

1. Practice the inspection, removal and installation of the exhaust system.
2. When you think you can perform this task, take the Performance Test.

RESOURCES

1. Shop engine #1 Red stand, 350 CDI, single exhaust V-8.
2. Performance Test for task B-06.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	06	4

PERFORMANCE TEST FOR TASK NO. B-06

RVTC

IN-9043-B-06

TASK:

Repair Exhaust System

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will repair exhaust system. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Was the student wearing safety glassed?		
2.	Was the exhaust manifold inspected?		
3.	Was the exhaust pipe inspected?		
4.	Was the muffler inspected?		
5.	Was the tail pipe inspected?		
6.	Were the exhaust hangers inspected?		
7.	Were the exhaust clamps inspected?		
8.	Were necessary repairs listed on the work order?		
9.	Was the exhaust system checked for leaks or damage before repairs were made?		
10.	Were any parts which could have been used again damaged during the process of removing worn parts?		
11.	Were all parts installed so that no rattles were present?		
12.	Was the exhaust system leak checked after the repair was complete?		
☐ ATTAINED ☐ NOT ATTAINED			
Score _____		EVALUATOR'S SIGNATURE _____	
DEPT.	PROG.	DUTY	TASK
IN	9043	B	06
		Page 1 of 1	

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VO-TECH CENTER

7700 State Road 544 N
Winter Haven, Florida 33880

IN-9043-B-07

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Identify Engine Components

DUTY:

Performing Maintenance and Repair on Drive Train

PURPOSE :

As an auto mechanic you will be repairing and replacing engine parts for customers. Your job will be much easier if you are able to identify the parts by sight. This Learning Guide will give you practice in identifying the most common engine parts.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	B	07	

REVISED :

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

GIVEN: at least twenty-six engine and related parts,

YOU WILL: identify engine parts.

HOW WELL: You must successfully complete the Written Test.
Your performance will be assessed by your instructor using the Performance Test on pages 82-83.

NOTE:

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Identify operating principles of gasoline engines.
2. Identify fuel system components.
3. Identify air system components.
4. Identify exhaust and emission control system components.
5. Identify engine block assembly, valve train, seal and gasket components.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	07

ENABLING OBJECTIVE NO. 1
RVTC

Identify operating principles of gasoline engines.

LEARNING STEPS

1. View Resource No. 1 to become familiar with gas engine fundamentals.
2. Read Resource No. 2 and ask the instructor to point out these components.
3. Read Resource No. 3 for an introduction on how a gasoline engine operates.
4. Evaluate your knowledge by completing the Self-Check
5. Go on to Enabling Objective No. 2.

RESOURCES

1. Hoffman slide/tape units: 2.5.A and 2.5.P.
2. a. Instruction Sheet enclosed, Engine Components
b. Instructor
3. Instruction Sheet enclosed, Basic Principles of the Gasoline Engine
4. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	07	1

INSTRUCTION SHEET

RVTC

PAGE 1 OF 1Engine Components

You will identify the following engine components.

Ask your instructor to point out the following engine components on an actual automobile.

1. fuel pump
2. fuel filter
3. carburetor
4. air filter
5. PCV valve
6. oil pump
7. oil filter
8. valves
9. rocker arm assembly
10. hydraulic valve lifters
11. valve cover gasket
12. vacuum modulator
13. transmission rear seals
14. piston rings
15. engine bearings

DEPT	PROG	DUTY	TASK	EN OBJ
IN	9043	B	07	1

Basic Principles of the Gasoline EngineEngine Construction

The first step in understanding automotive engine construction and operation is to understand what goes on inside the engine. No matter how many cylinders an engine has, whether 2, 4, 6 or 8 the same actions take place in each cylinder. We can learn about engine construction and operation by studying a single cylinder engine (Figure 1). This engine is a 4 stroke cycle, internal combustion gasoline engine.

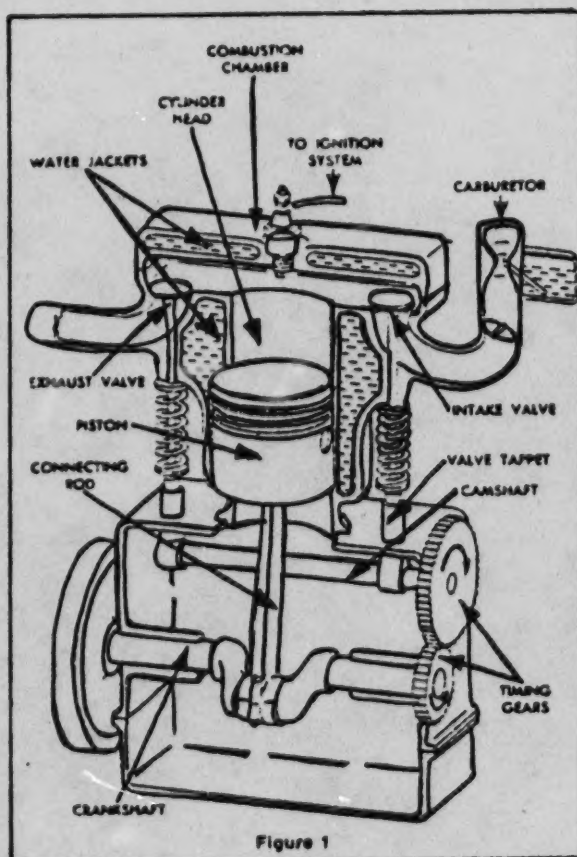


Figure 1

Cylinder and Piston

Figure 1 shows a cutaway of a single cylinder gasoline engine. -- The upper, or head end is open. The piston is a hollow metal tube with the top end closed. The piston moves up and down in the cylinder. This up and down movement is produced by the burning of fuel in the cylinder (internal combustion) and results in the production of power from the engine.

Connecting Rod and Crank

The up and down movement of the piston is called reciprocating motion. This reciprocating motion must be changed to rotary motion so the wheels of the vehicle can be made to rotate. This change is accomplished by linking the piston to the crankshaft with a connecting rod. As the piston moves up and down in the cylinder, the upper end of the connecting rod moves up and

down with it. The lower end of the connecting rod also moves up and down. However, because it is attached to the crankshaft, it must also move in a circle.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	1

Each movement of the piston from top to bottom or from bottom to top is called a stroke. The piston takes two strokes as the crankshaft makes one complete revolution, an upstroke and a downstroke. When the piston is at the top of a stroke, it is said to be at top dead center. When the piston is at the bottom of a stroke, it is said to be at bottom dead center.

Valves

There are two valves (Figure 1) at the top of the cylinder. A valve is an accurately machined plug that fits into a machined opening at the top of the cylinder. When the valve is resting in this opening, it is said to be seated. When a valve is so positioned, it is closed and the opening is sealed off. When the valve is pushed off its seat it is opened. The two valves in the cylinder are closed part of the time and opened part of the time. One of the valves, called the intake valve, opens to admit a mixture of fuel and air into the cylinder. The other valve, called the exhaust valve, opens to allow the escape of burned gases after the fuel and air mixture has burned.

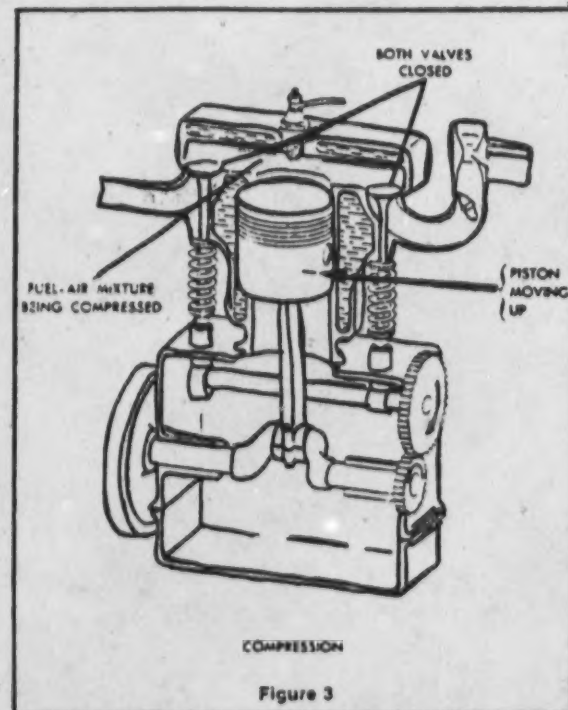
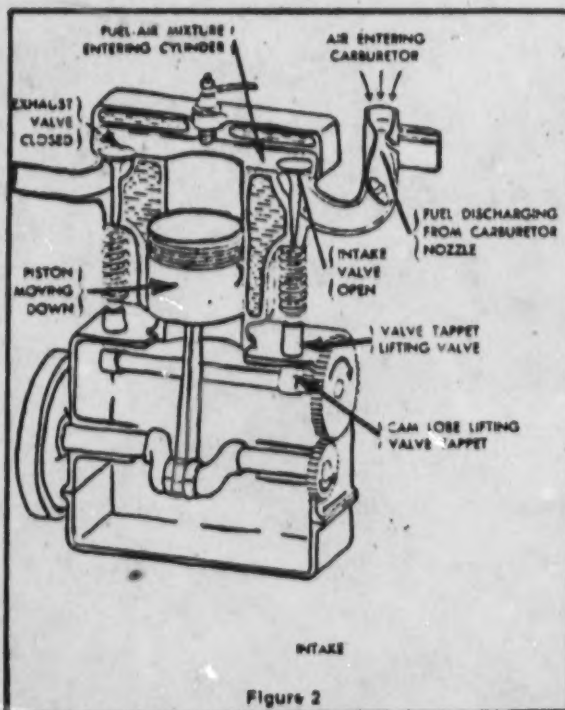
Intake Stroke (Figure 2 on the following page)

The actions that take place within the engine cylinder may be divided into four basic parts, which are called strokes. The first stroke in the sequence is called the intake stroke. During this stroke the piston is moving downward and the intake valve is open. This downward movement of the piston produces a partial vacuum in the cylinder. Air rushes into the cylinder past the open intake valve. In the engine the rushing air passes through the carburetor before it enters the cylinder. The carburetor charges the air with gasoline vapor to produce a combustible mixture.

Compression Stroke (Figure 3 on the following page)

When the piston reaches bottom dead center at the end of the intake stroke and is therefore at the bottom of the cylinder the intake valve closes. This seals the upper end of the cylinder. As the crankshaft continues to rotate it pushes up through the connecting rod on the piston. The piston is therefore pushed upward and compresses the combustible mixture in the cylinder. This is called the compression stroke. The mixture is compressed to about an eighth of its original volume. Compressing the mixture in this way makes it still more combustible as the mixture heats up and the energy in the fuel is concentrated into a smaller space.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	1



Power Stroke (Figure 4 on the following page)

As the piston reaches top dead center at the end of the compression stroke and has moved to the top of the cylinder the compressed fuel and air mixture is ignited. This ignition is produced by the ignition system. The ignition system causes an electric spark to occur suddenly in the cylinder. The spark sets fire to the fuel and air mixture. The mixture burns rapidly, expanding the gases in the mixture. This force, or thrust, pushes the piston down. The thrust is carried through the connecting rod to the crankshaft. The crankshaft is given a powerful twist. This is called the power stroke. This turning effort is rapidly repeated in the engine and carried through gears and shafts. It will turn the wheels of a vehicle and cause it to move along the highway.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	1

has a number of cams on it. These cams are simply raised sections, or collars, with high spots on them. When the camshaft rotates the high spots (called lobes) move around and push away anything they are in contact with. Riding on each cam is a cylindrical valve tappet. As the lobe moves up under the valve tappet, the valve tappet is raised. This upward movement causes the valve above it to be raised also. Thus the valve is raised up off its seat in the cylinder so that the valve opens. When the lobe on the cam moves on around out of the way the pressure of the spring under the valve forces the valve to move down and reset.

Engine Accessory Systems

The carburetor supplies vaporized fuel to the air passing into the engine cylinder on the intake stroke. The carburetor is a unit in the fuel system. Another accessory system is the ignition system which ignites the compressed fuel and air mixture in the cylinder at the end of the compression stroke. A third accessory system is the lubrication system which supplies lubricating oil to the various moving parts of the engine. The oil lubricates all parts, such as the piston, bearings, crankshaft and valve stems that rotate or slide in or on other parts. This oil permits the parts to move easily so that little power is lost and wear on parts is kept to a minimum. A fourth system is the cooling system. In the simple engine shown in Figure 1, water is used as the cooling medium. Water circulates in jackets around the cylinder and in the cylinder head. This water removes part of the heat produced by the combustion of the fuel and air mixture. This action prevents the engine from overheating and thereby being damaged.

Typical Automotive Engines

Multi-cylinder engines can be classified according to the arrangement of cylinders -- Figures 7, 8 and 9 on the following page.

1. In-line Engines -- All cylinders are in a straight line above the crankshaft (Figure 7).
2. V or Y Type Engines -- There are two banks of cylinders in a V shape above the crankshaft (Figure 8).
3. Opposed Engines -- There are two rows of cylinders opposite the crankshaft (Figure 9).

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	1

Figure 4

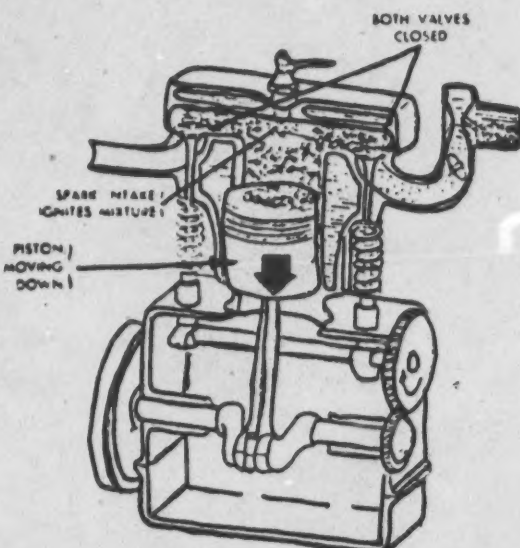


Figure 4

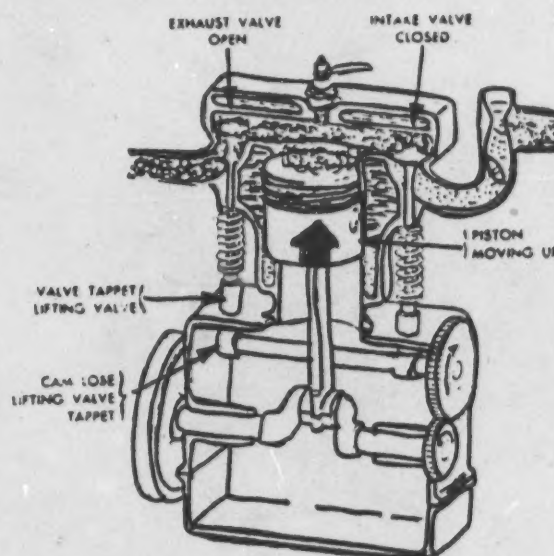
Exhaust Stroke (Figure 5)

After the fuel and air mixture has burned it must be cleared from the cylinder. This is done by opening the exhaust valve just as the power stroke is finished and piston starts back up on the exhaust stroke. The piston forces the burned gases out of the cylinder past the opened exhaust valve. The four strokes (intake, compression, power and exhaust) are continuously repeated as the engine runs.

Valve Mechanism Action

There are various ways of causing the intake and exhaust valves to open and close. One method is shown in Figure 6. A gear on the crankshaft is meshed with a second gear on another shaft. When the crankshaft turns the other shaft must also turn. This second shaft is called the camshaft because it

PAGE 4 OF 6



EXHAUST

Figure 5

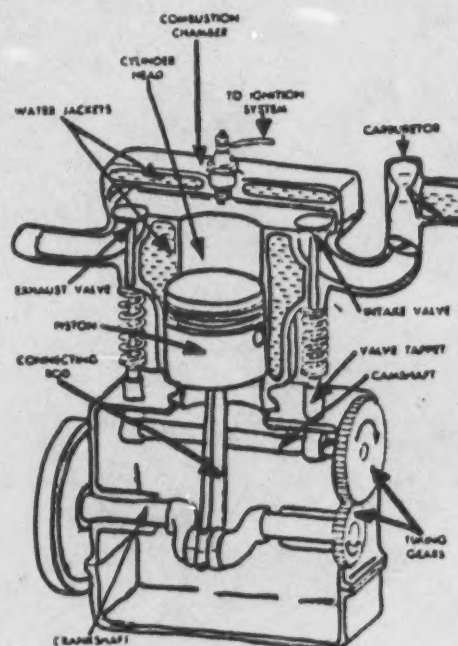


Figure 6

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	1

The in line engine is popular in compact cars and in farm and industrial equipment. The V type engine is popular in higher horsepower output automotive engines. The opposed air-cooled engine has had its more popular use in the Corvair and Volkswagen.

IN-LINE

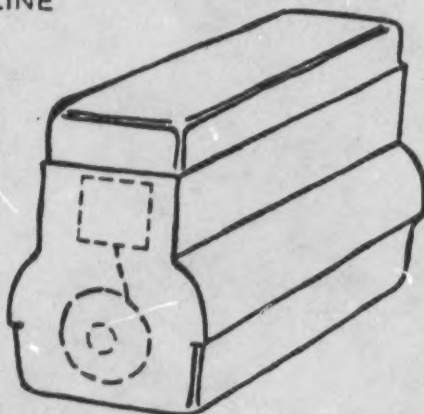


Figure 7

V-TYPE

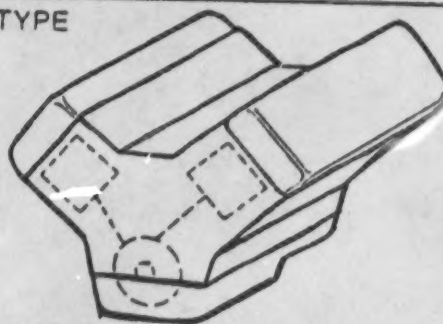


Figure 8

OPPOSED

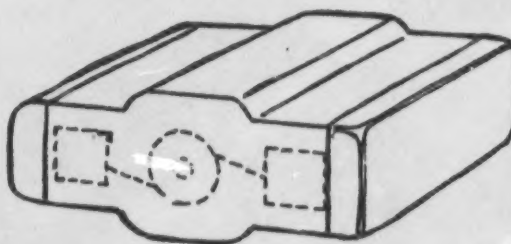


Figure 9

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	1

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by answering the items below on a separate sheet of paper.

1. The fuel and air mixture rushes into the cylinder during the _____ stroke.
2. During the _____ stroke, the fuel and air mixture is compressed to about one-eighth its original volume.
3. After the fuel and air mixture has been ignited by the spark plug the piston moves down during the _____ stroke.
4. After the fuel and air mixture has been burned it is cleared from the cylinder during the _____ stroke.
5. If you have a 6 cylinder engine with all 6 cylinders in a row, it is called a/an _____ engine.
6. If you have two rows of cylinders above the crankshaft in a V shape, you have a _____ engine.
7. Some engines have two rows of cylinders directly opposite each other. These engines are called _____ engines.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	1

SELF-CHECK

RVTC

Answer Key

1. intake
2. compression
3. power
4. exhaust
5. in line
6. V type
7. opposed

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	1

ENABLING OBJECTIVE NO. 2
RVTC

Identify fuel system components.

LEARNING STEPS

1. Read Resource No. 1 for an introduction to the main fuel system parts and their purpose.
2. View Resource No. 2 to become familiar with the principles of carburetion.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 3.

RESOURCES

1. Instruction Sheet enclosed Fuel System
2. Hoffman slide/tape unit: 7.1.1
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	07	2

INSTRUCTION SHEET

RVTC

PAGE 2 OF 13Fuel Filters

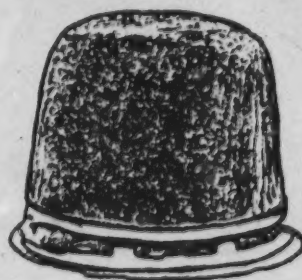
Most fuel systems contain a fuel filter to prevent dirt particles from entering the carburetor. This could impair carburetor efficiency. The carburetor is the most complicated component of the modern day automobile.

Modern day engines are equipped with a fuel filtration system designed to allow sufficient flow of fuel to the carburetor while removing the smallest particles of dirt from the fuel.

Fuel filters may be found in one of three locations in the fuel system. In the fuel pump, between the pump and carburetor or in the carburetor itself.

Gasoline engines use three types of fuel filters: strainer, screen or pleated paper.

Figure 2 shows a "strainer" type fuel filter. This filter medium consists of small fibers molded into a suitable shape for installation in a see through glass bowl or metal canister. The filter is porous enough to allow passage of the fuel but will prevent harmful contaminants from passing through. This type of filter is normally mounted in the fuel pump.



DEPT	PROG	DUTY	TASK	EN OBJ
IN	9043	B	07	2

INSTRUCTION SHEET

RVTC

PAGE 1 OF 13

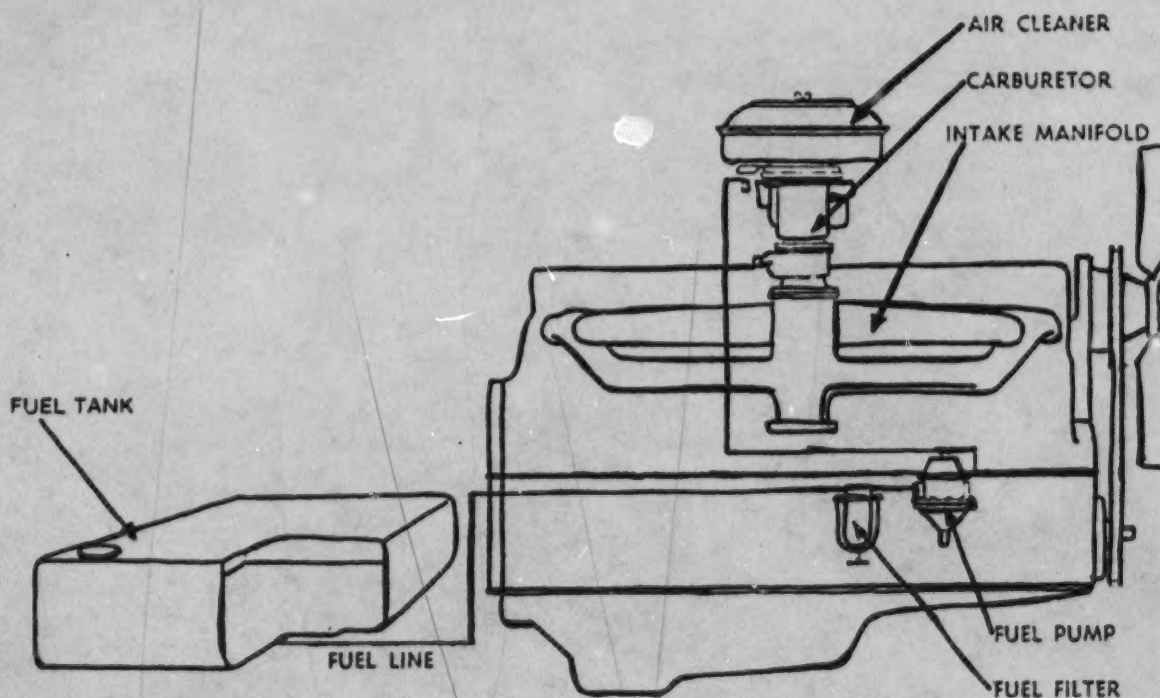
Fuel System

Figure 1

Figure 1 shows a typical fuel system. Fuel is stored in the fuel tank. A fuel pump moves fuel from the tank to the carburetor whenever it is mixed with proper portions of air. This changes it from a "liquid" to an "atomized" state.

These fuel and air mixture particles enter the manifold to be distributed to each cylinder. The heat of the intake manifold causes the fuel and air mixture to "vaporize" for easier and more complete burning within the combustion chamber.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	2

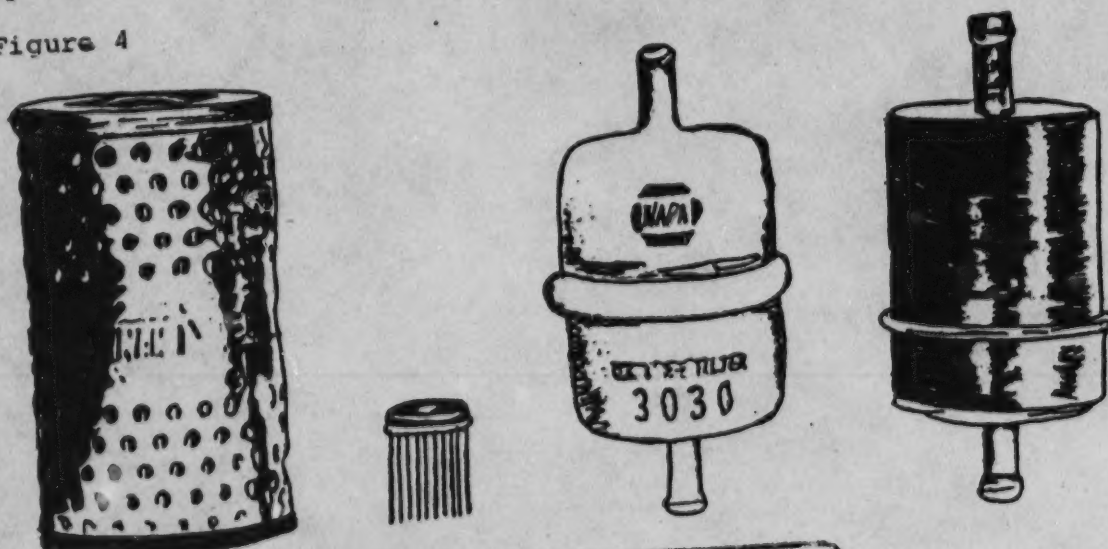


Figure 3

In Figure 3, a screen type fuel filter is shown. The filter is normally mounted in the carburetor fuel inlet fitting and the fuel line must be disengaged to replace the filter. Most screen type filters are made of woven brass wire or porous bronze. The openings through the filter are small enough to stop harmful contaminants from passing through and entering the carburetor.

The most widely used fuel filter is shown in Figure 4 and it is the paper type. Paper filters will remove smaller sized and larger amounts of dirt particles than will the screen or strainer types. These filters are usually mounted in the fuel line between the pump and carburetor, but may sometimes be found in other parts of the system.

Figure 4



DEPT.	PROG.	DUTY	TASK	EN OBJ.
IN	9043	B	07	2

Fuel filters are a necessary and important component of any fuel system and they should be properly maintained for good engine performance.

Fuel Pump (Figure 5)

The fuel pump transfers fuel from the fuel tank to the carburetor. It must have enough capacity to supply the engine with fuel under all operating conditions. It should also maintain sufficient pressure in the line of the carburetor to keep the fuel from boiling (vapor lock) due to high underhood engine heat. Some fuel pumps have built-in filters to assure the cleanliness of fuel delivered to the carburetor. Fuel pumps can be either mechanically or electrically operated.

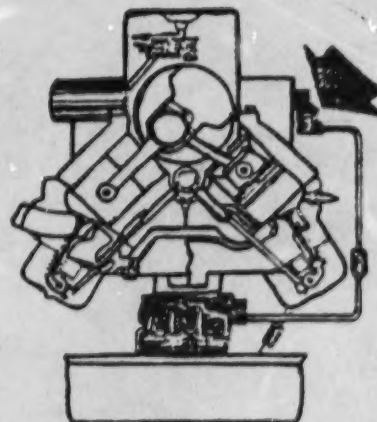
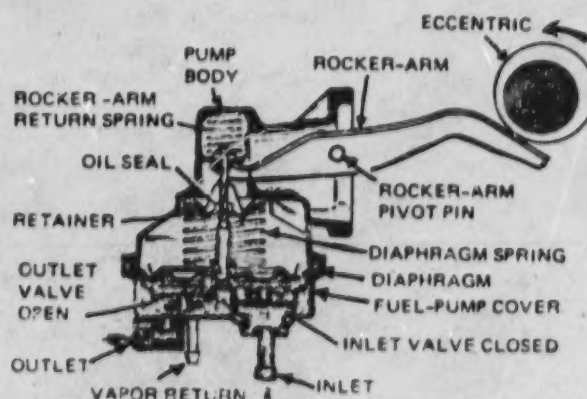


Figure 5

Mechanical Fuel Pump

Figure 6 shows a cutaway of a typical mechanical fuel pump. The diaphragm is released on the return stroke and the diaphragm forces it downward. This creates pressure in the chamber causing the inlet valve to close and the outlet valve to open. This causes fuel to be moved under pressure to the carburetor.

Figure 6



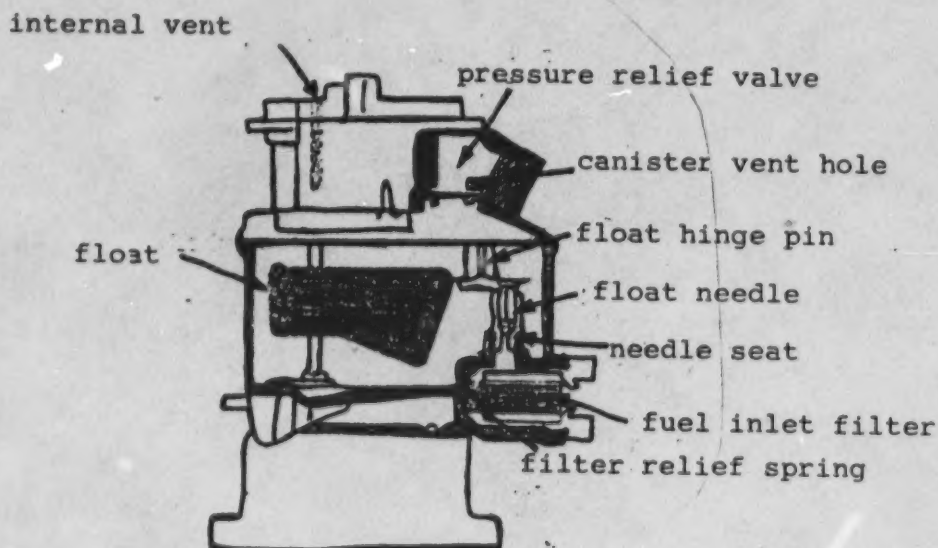
DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	2

They are: float, idle and low speed, main metering, power, choke and accelerating pump.

Float Circuit

Efficient operation of the engine is dependent upon receiving the correct amount of fuel under all operating conditions. Therefore, it is the purpose of the float circuit to store fuel in the carburetor bowl and maintain the fuel at a specified or required level. This is accomplished by means of a movable float which is raised or lowered as the fuel level increases or decreases. This moves the needle valve into or out of the needle seat. This float action controls the needle valve movement and permits fuel to enter or to be stopped according to float height.

Figure 8



DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	2

INSTRUCTION SHEET

RVTC

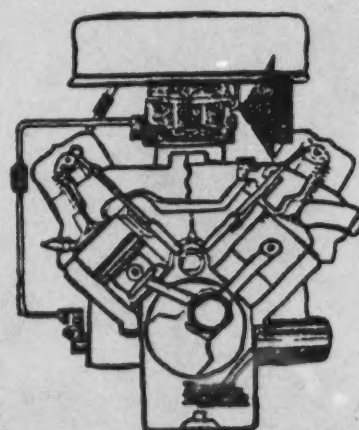
PAGE 5 OF 13

Electric Fuel Pump

The advantage of the electric fuel pump is that it can be mounted anywhere between the fuel tank and carburetor. It will eliminate vapor lock when installed as close to the fuel tank as possible. With fuel under pressure it is difficult for vapor to form, even if the fuel lines get too hot.

Engines will not run on "liquid" gasoline. A metering device must be used to mix fuel and air in the proper portions to accommodate all different types of starting and driving ranges. Example: Cold or hot starting, idle, part throttle, acceleration and high speed operation. The carburetor (Figure 7) performs this function.

Figure 7

Carburetor Manufacturers

There are five carburetor manufacturers supplying carburetors for use on American made vehicles. They are: Carter, Ford, Holley, Rochester and Stromberg.

Because each manufacturer produces single, two and four barrel carburetors of different designs for different vehicles it would require a large manual to describe the operating principles of each circuit. All carburetors operate under the same principle of pressure difference and only the method of construction will vary. The following will fully describe the operating principles of the Rochester Model 2GC two barrel carburetor.

Once the general theory of carburetion is understood, it is a simple matter to apply that theory to any make carburetor.

Basic Carburetor Systems

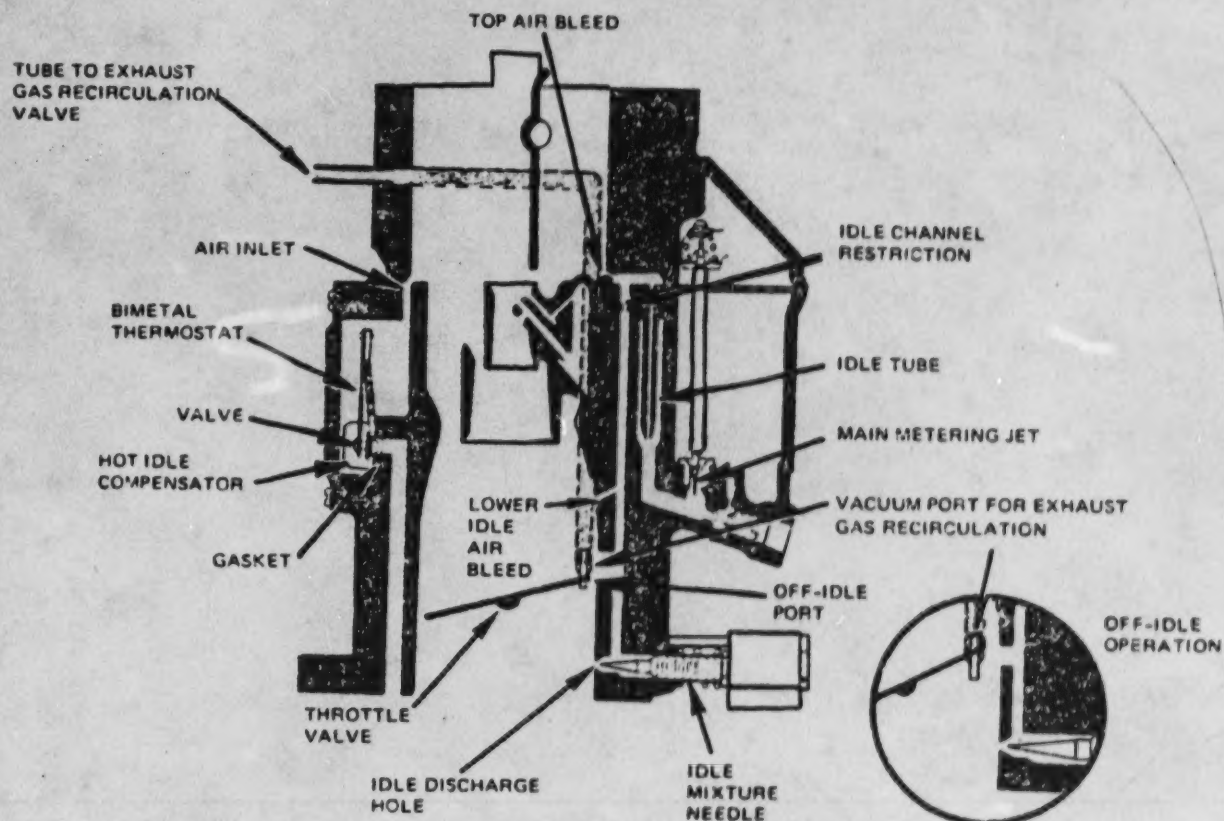
There are six basic circuits used in Rochester Model 2GC 2 barrel carburetor.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	2

Idle Circuit (Figure 9)

The purpose of the idle circuit is to provide the proper air and fuel mixture ratio to the engine at idle and at speeds up to approximately 20 to 25 miles per hour.

Figure 9

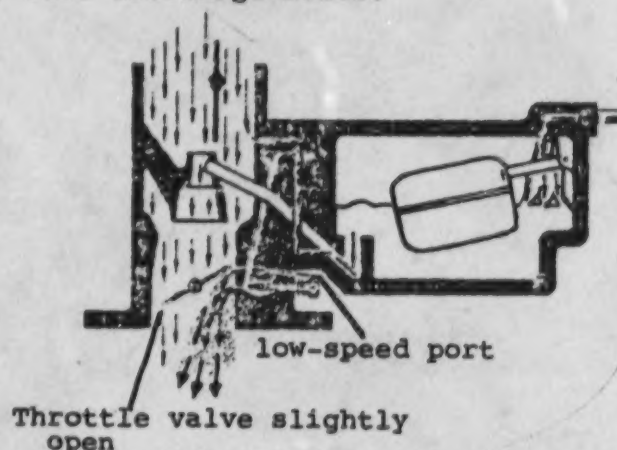


DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	2

Low Speed Circuit (Figure 10)

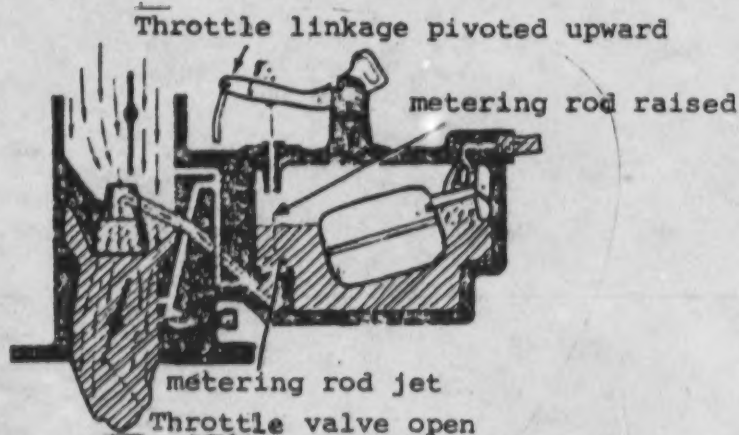
As engine speed slowly increases due to the further opening of the throttle valves, permitting more air to enter, an additional quantity of fuel is needed to combine with the extra air. This is accomplished by the secondary edle discharge holes.

Figure 10

Main Metering Circuit (Figure 11)

The purpose of the part throttle or main metering circuit is to provide fuel during the transition period from low speed to wide open throttle operation.

Figure 11



DEPT.	PRG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	2

INSTRUCTION SHEET

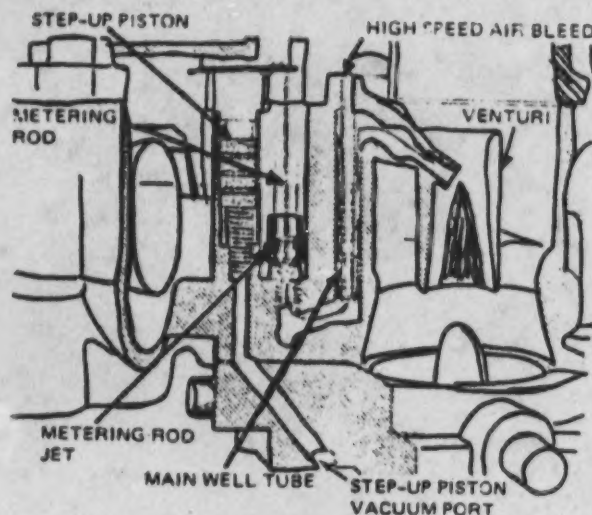
RVTC

PAGE 9 OF 13

Power Circuit (Figure 12)

The purpose of the power circuit is to provide the extra quantity of fuel required when more power is desired or extreme high speed driving is to be maintained.

Figure 12

Accelerator Pump (Figure 13 on the following page)

The purpose of the accelerator pump is to provide the momentary additional fuel needed to sustain smooth engine operation during rapid acceleration.

Choke (Figure 14 on the following page)

The purpose of the choke is to provide an extremely rich fuel mixture for cold engine starting and operation. This rich mixture is required because fuel vapor has a tendency to condense into droplets of raw gasoline upon coming into contact with the cold wall of the intake manifold. This action seriously robs the amount of fuel which normally would reach the engine cylinders to be ignited and burned.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	2

INSTRUCTION SHEET

RVTC

PAGE 10 OF 13

Figure 13

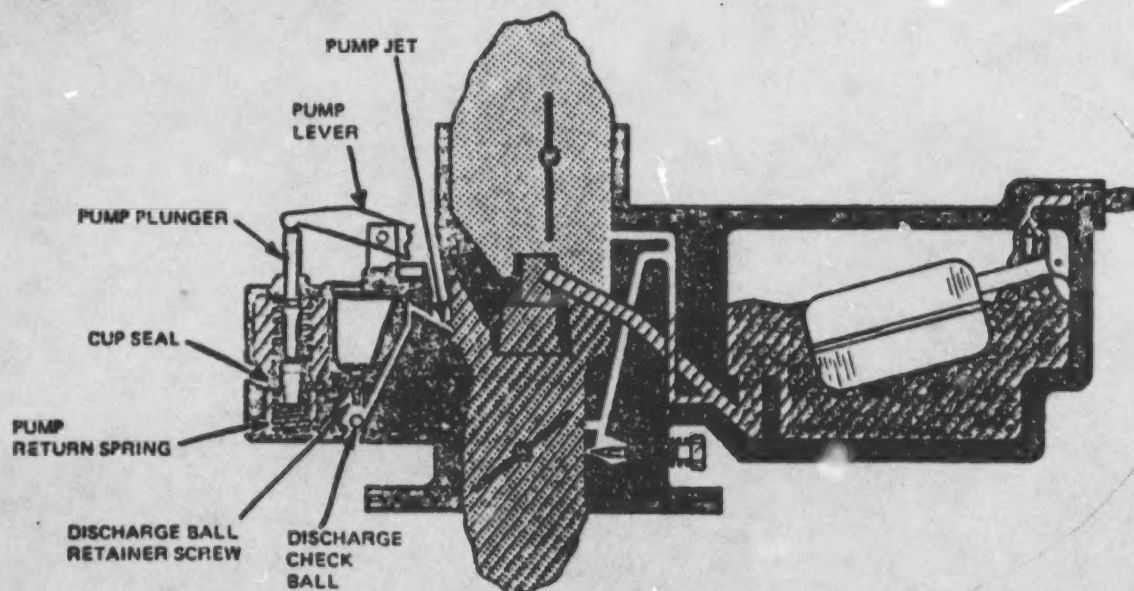
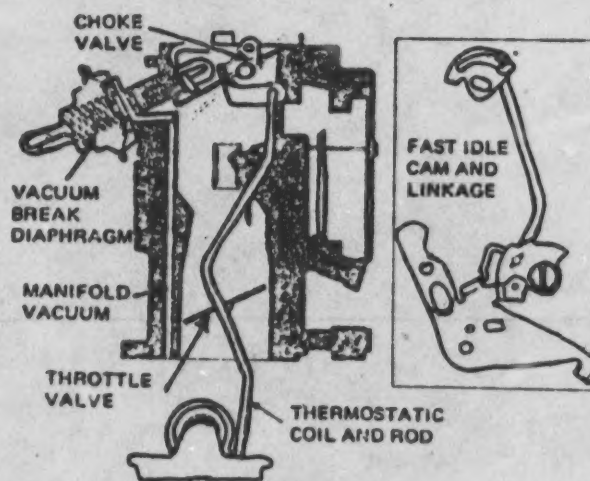


Figure 14



DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	2

INSTRUCTION SHEET

RVTC

PAGE 11 OF 13

One, Two and Four Barrel Carburetor Identification

For reference purposes, shown on this and the following pages are actual pictures of single, two and four barrel carburetors.

When principles of operation of a single barrel carburetor are understood then a four barrel carburetor no longer seems complicated.
(Figure 15, 16 and 17)

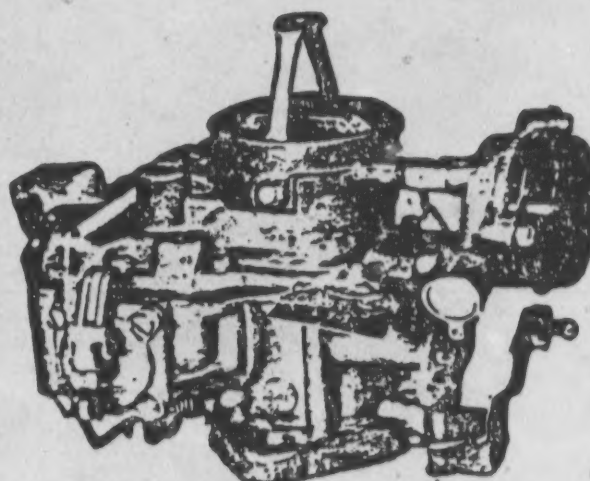


Figure 15 Single Barrel Carburetor

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	2

INSTRUCTION SHEET

RVTC

PAGE 12 OF 13

A two barrel carburetor is essentially two single barrel carburetors joined together.

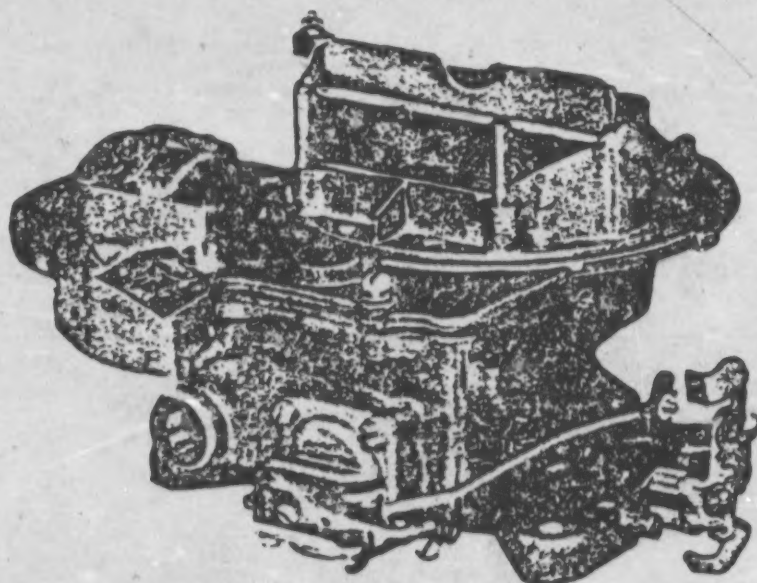


Figure 16 Two Barrel Carburetor

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	2

INSTRUCTION SHEET

RVTC

PAGE 13 OF 13

A four barrel carburetor is essentially two of the two barrel carburetors joined together.

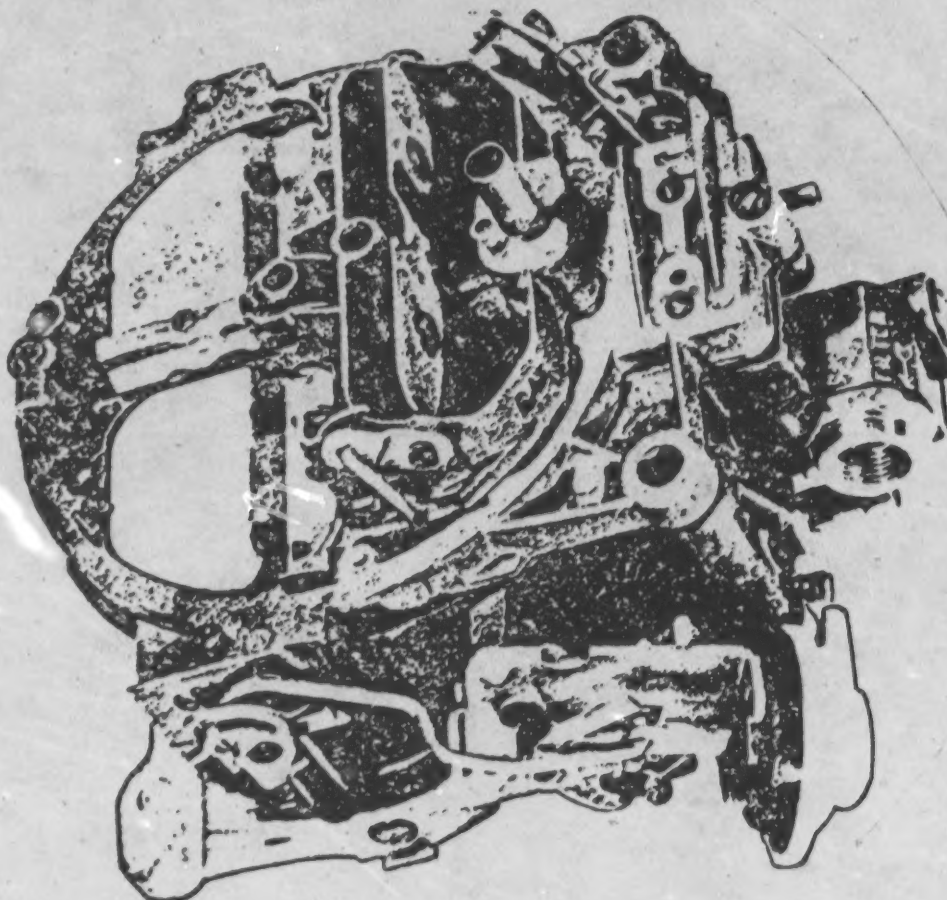


Figure 17 Four Barrel Carburetor

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	2

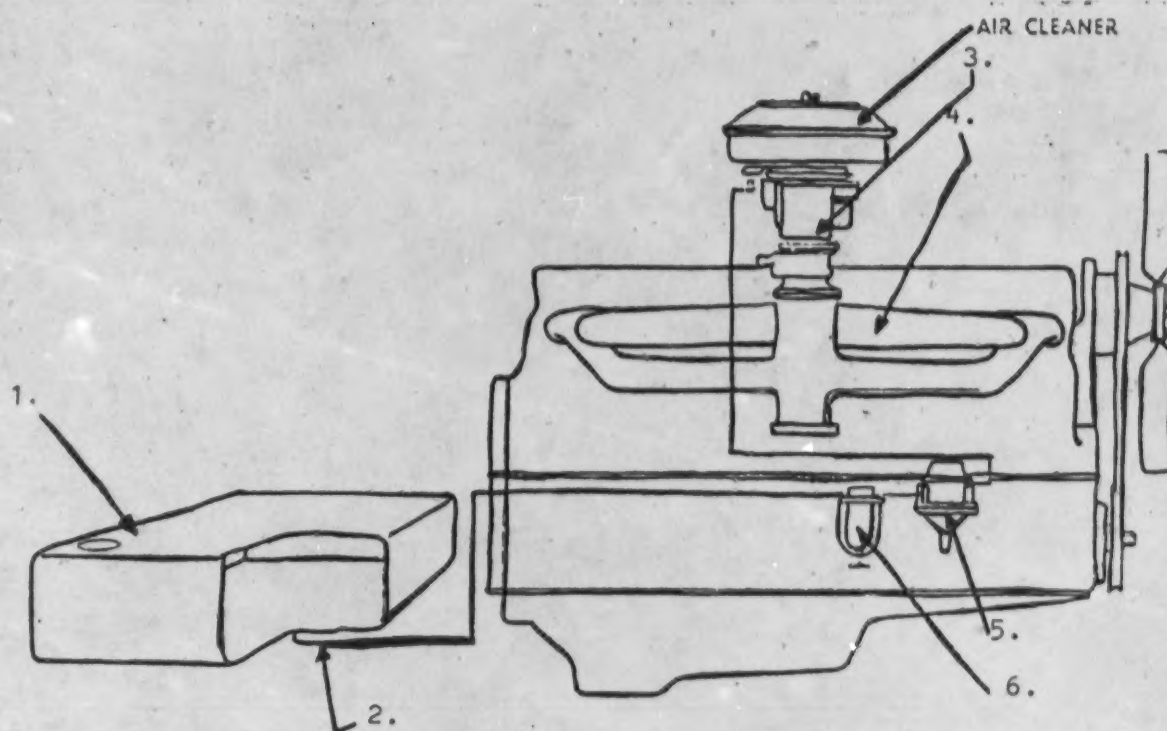
SELF-CHECK

RVTC

Directions

Evaluate your knowledge by answering the items below on a separate sheet of paper.

1. The _____ prevents dirt particles from getting into the carburetor.
2. The _____ forms an air and fuel mixture for the engine.
3. A _____ pumps fuel from the fuel tank into the carburetor.
4. List the four common carburetor manufacturers.
5. Generally, _____, _____ and _____ barrel carburetors are most common.



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	8	07	2

SELF-CHECK

RVTC

Answer Key

1. fuel filter
2. carburetor
3. fuel pump
4. Ford, Carter, Rochester, Holley and Stromberg
5. one, two and four

Identification

1. fuel tank
2. fuel line
3. carburetor
4. intake manifold
5. fuel pump
6. fuel filter

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	2

ENABLING OBJECTIVE NO. 3

RVTC

Identify air system components.

LEARNING STEPS

1. Read Resource No. 1 to become familiar with the air system parts and their purpose.
2. Evaluate your knowledge by completing the Self-Check.
3. Go on to Enabling Objective No. 4.

RESOURCES

1. Instruction sheet enclosed, Air System
2. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	07	3

INSTRUCTION SHEET

RVTC

PAGE 1 OF 2Air System

Present day automobile engines are commonly referred to as gasoline engines.

Air Filters

Every engine is subject to damage from abrasive material entering the air intake system. Minute quantities of any fine dust or dirt that are permitted to get between the surfaces of pistons, bearings, valve stems or other parts would set up intolerable friction and wear. The whole story of automobile engine progress is keyed to advances in filtration.

The larger the engine the more air it must gulp for maximum performance.

A modern air filtration system was developed to meet the demands of engines-- "dry type" air filtration.

Figures 1 and 2 show a typical dry type air filtration system consisting of the metal housing and replacable dry type air filters. The filter is easily serviced by removing the cover plate and replacing the dry type filter.

The special porous paper used in these high quality filters passes the air very freely. Yet, it cleans out even the most minute particles of dust and dirt. The top and bottom of the filter is sealed air tight with a soft, pliable material.

A heavy perforated metal outer wrap is used to support and protect the paper. A special metal screen is inside the filter to protect it from the engine backfire.

DEPT	PROG	DUTY	TASK	EN OBJ
IN	9043	B	07	3

INSTRUCTION SHEET

RVTC

PAGE 2 OF 2

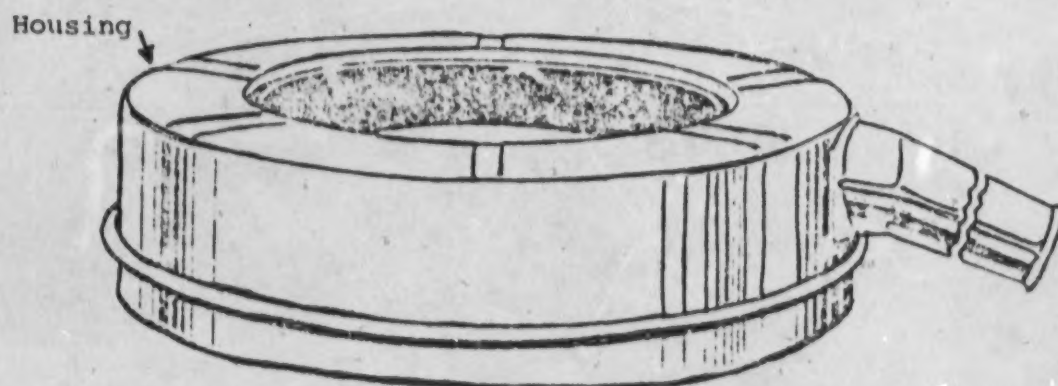
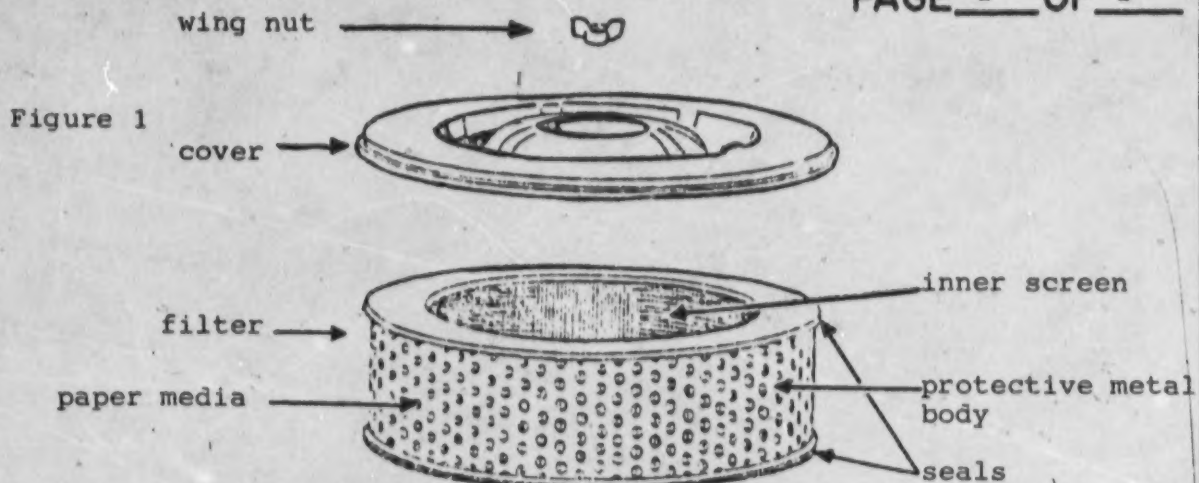
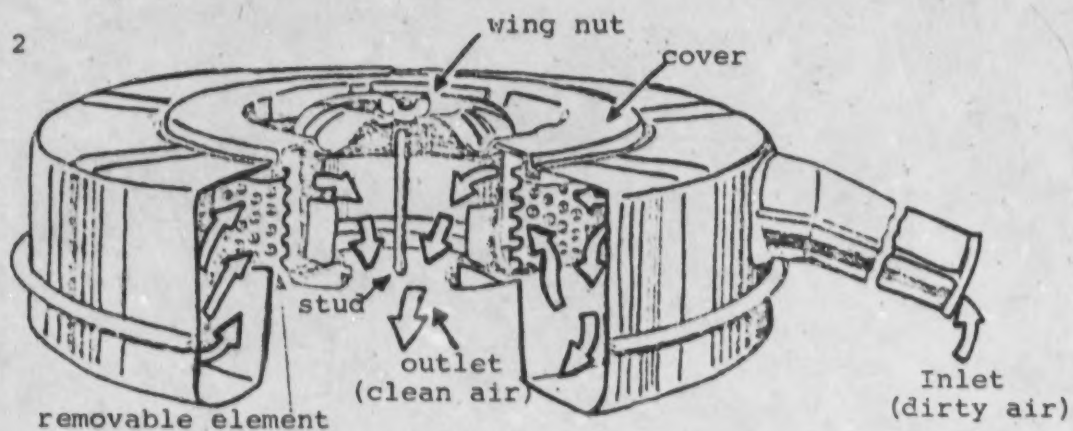


Figure 2



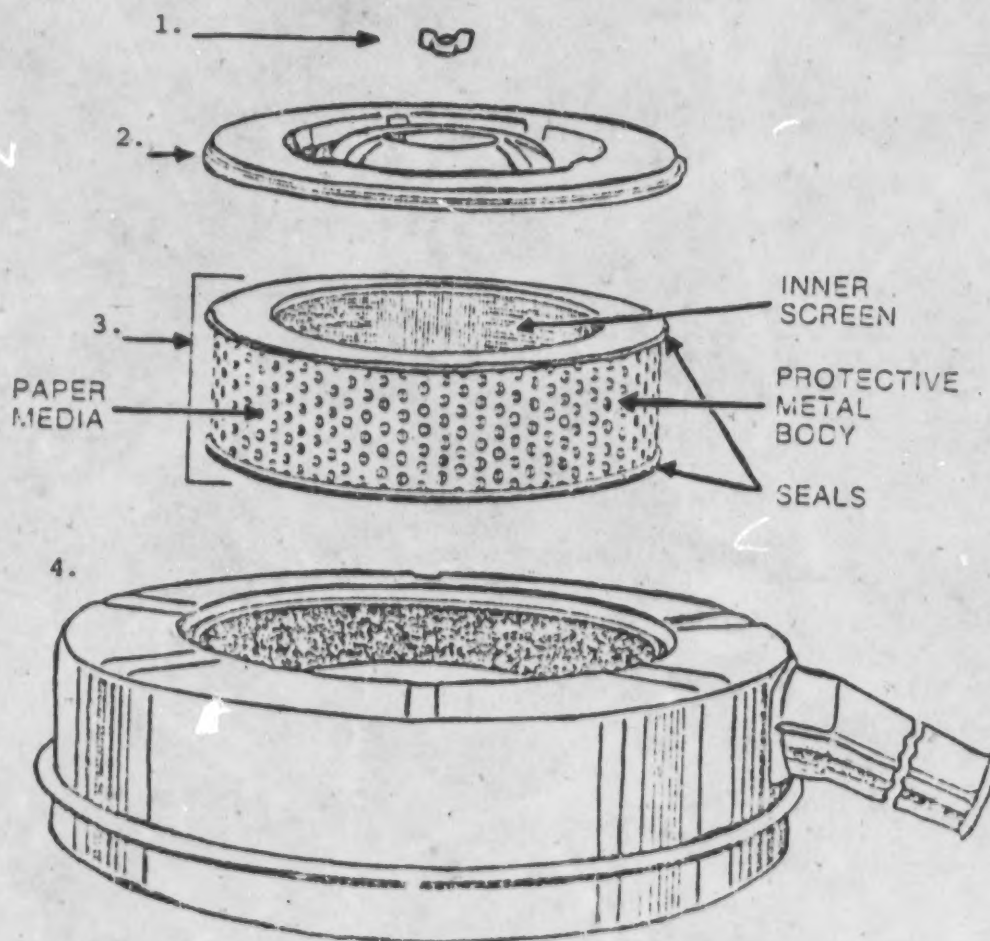
DEPT.	PROG.	DUTY	TASK	EN OBJ.
IN	9043	B	07	3

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by identifying the items below on a separate sheet of paper.



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	P	07	3

SELF-CHECK

RVTC

Answer Key

1. wing nut
2. cover
3. air filter
4. housing

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	07	3

ENABLING OBJECTIVE NO. 4.

RVTC

Identify exhaust and emission control system components.

LEARNING STEPS

1. Read Resource No. 1 for information on the exhaust system parts and their purpose.
2. Evaluate your knowledge by completing the Self-Check.
3. Go on to Enabling Objective No. 5.

RESOURCES

1. Instruction sheet enclosed, Exhaust System
2. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	07	4

INSTRUCTION SHEET

RVTC

PAGE 1 OF 14Exhaust System

Engine power comes from a series of air and gasoline explosions. The noise from these explosions is quite loud. A great amount of noise also comes when the exhaust valve opens and the piston forces the burnt gases out of the cylinder. The resulting sound waves blast out of the engine during these explosions. The high pressure gases and acid-bearing water vapor must be contained, controlled and subdued. This is the job of the automobile exhaust system.

The exhaust system must contain and control this continuous stream of sound waves and hot, high pressure exhaust gas. Although, it must permit the gas vapors to pass freely through, so as not to build up excessive back pressure. Back pressure occurs when the gases are restricted and it acts as a brake against the engine. It can cut down on gas mileage, engine power, performance and cause severe engine damage.

The greatest cause of failure of exhaust system parts is from internal corrosion resulting from condensate acid moisture. This moisture is chemically produced by the combustion of air and gasoline. Most exhaust system parts actually wear from the inside out.

Condensate acid moisture is most destructive when both the engine and the exhaust system parts are cold. When the engine is fully warmed up the hot gases evaporate. As a result, those parts closest to the engine heat up first and their deterioration is slower than that of parts farther back in the system. Consequently, exhaust pipes tend to have a much longer life expectancy than mufflers or tailpipes. Tailpipes and mufflers take longer to warm up and collect more of the acid condensate.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	4

INSTRUCTION SHEET

RVTC

PAGE 2 OF 14Exhaust Manifold (Figure 1)

Banks of pipes which collect the expelled exhaust gases from each cylinder and carry them away from the engine and into the exhaust system.

Figure 1

Exhaust Pipe (Figure 2)

A pipe which carries the collected gases and vapor from the exhaust manifold to another component of the exhaust system. A "Y" pipe is an exhaust pipe which connects both exhaust manifolds of a "V" engine to form a single exhaust system. An "H" pipe consists of right and left hand exhaust pipes. Each pipe comes from a manifold and is connected by a balance pipe to form a dual exhaust system.

Figure 2

"Y" Pipe



"H" Pipe



DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	4

INSTRUCTION SHEET

RVTC

PAGE 3 OF 14

Intermediate Pipe (Figure 3)

Also known as the extension pipe and connecting pipe. When used, it connects the exhaust pipe with the muffler or the resonator, whichever is first in the system. Its purpose is to carry the gases to the muffler for silencing or to the resonator for further silencing. Not all cars have intermediate pipes.

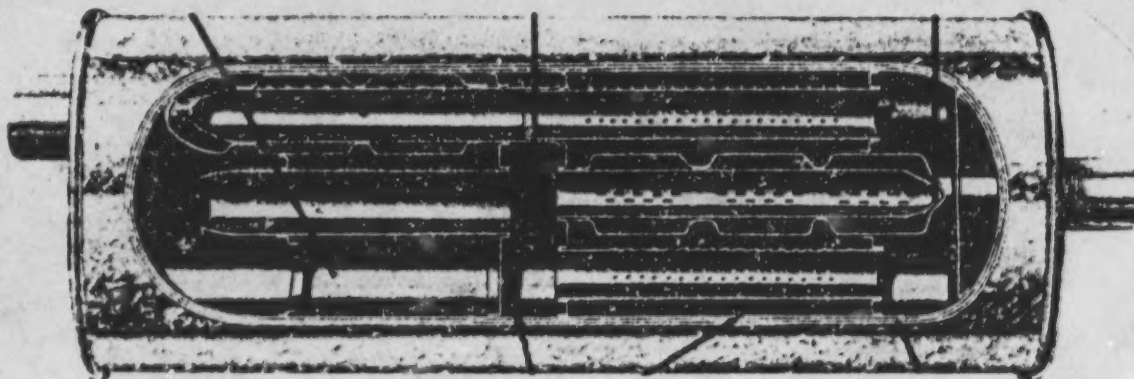
Figure 3

Muffler (Figure 4)

The main source of silencing exhaust gas noises. It is a combination of tuning chambers, baffle partitions and ventilated solid tubes. These are designed and balanced to absorb noise pulses while moving the exhaust gases and vapor smoothly out of the tailpipe. The muffler's location varies considerably, depending on the car model. Most mufflers are located toward the rear of the car.

Remember, specific mufflers are designed for specific cars and engines. Placing a muffler on a car which fits the space, but was not designed for that car can hinder performance. It can cause damage if too much back pressure is developed.

Figure 4



DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	4

INSTRUCTION SHEET

RVTC

PAGE 3 OF 14

Intermediate Pipe (Figure 3)

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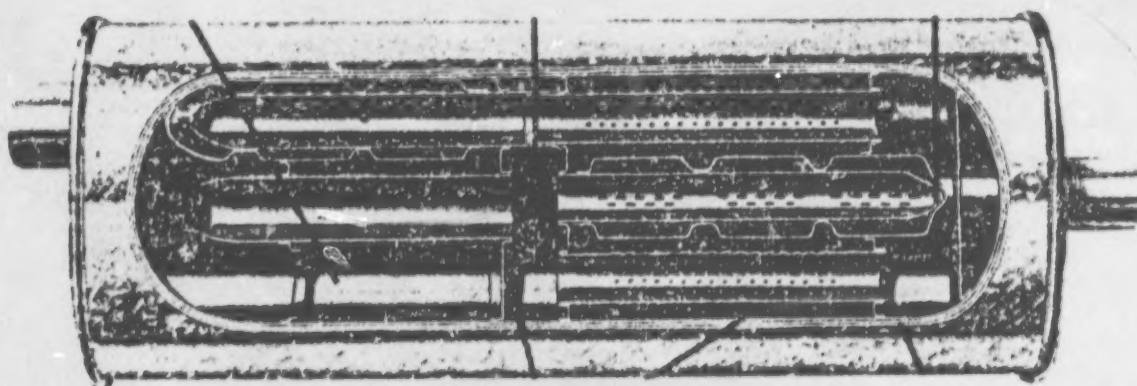
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Figure 4



DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	4

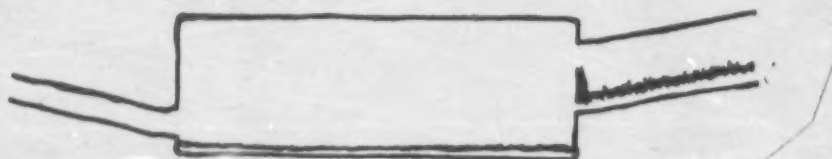
INSTRUCTION SHEET

RVTC

PAGE 4 OF 14Resonator (Figure 5)

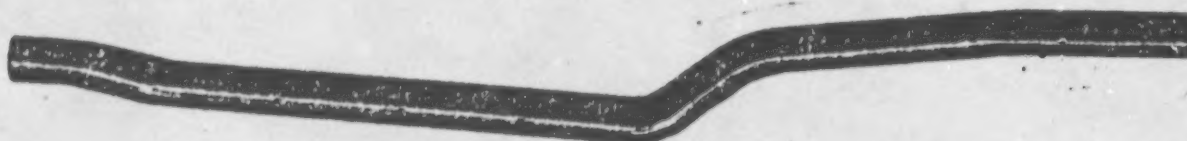
The resonator is a second, usually smaller silencing element placed on some exhaust systems. This is used when the amount of space available under the car does not permit complete silencing by the muffler. In systems using resonators, it smoothes out any loudness or roughness coming from the first muffler. Most resonators are located to the rear of the muffler in the exhaust and are visually similar to it. The resonator is also called a racket buster by some mechanics.

Figure 5

Tailpipe (Figure 6)

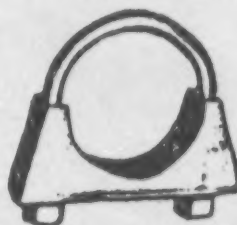
The tailpipe terminates the exhaust system and carries the subdued gases and vapor out of the car and directs them to a point where they cannot enter the passenger compartment.

Figure 6

Clamps (Figure 7)

Clamps are used to provide gas tight, leakfree connections at joints. Usually, where two pipes or a muffler and a pipe are joined together.

Figure 7



DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	4

INSTRUCTION SHEET

RVTC

PAGE 5 OF 14Hangers (Figure 8)

Hangers hold the clamps, pipes and muffler to the underbody of the car. They are flexible and absorb noise and road vibration. If they are too flexible, road vibration can break them. If too firm, road vibration and noise are transferred to the car's underbody. This results in a poor ride for passengers.

Figure 8

Gaskets (Figure 9)

Gaskets are used to insure tighter, leak-free connections between the exhaust manifold and the exhaust pipe. They are made from asbestos and pressed steel or sintered iron.

Figure 9

Crankcase and Exhaust Emission Control

The two main sources of air pollution from the motor vehicle due to unburned hydrocarbons and carbon monoxide entering the atmosphere are from either the crankcase or the exhaust tailpipe.

Methods used to prevent crankcase and exhaust emissions from reaching the atmosphere are as follows:

Crankcase Emissions -- The PCV (positive crankcase ventilation) system, installed on vehicles since 1962, prevents crankcase emissions from reaching the atmosphere by routing them back to the combustion chamber for burning.

There are two different systems in use -- the open system and the closed system.

The theory of operation is described as follows under Crankcase Ventilation Systems and How a PCV Valve Functions.

DEPT.	PROG	DUTY	TASK	EN OBJ.
IN	9043	B	07	4

INSTRUCTION SHEET

RVTC

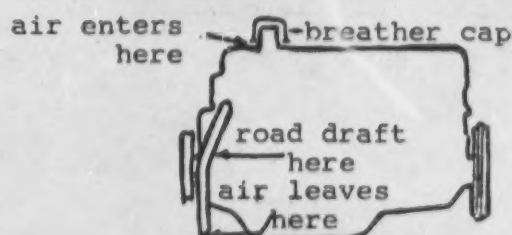
PAGE 6 OF 14Crankcase Ventilation Systems

Engines in passenger cars and trucks today utilize crankcase ventilation systems that may be divided into three general groups.

Group I (no smog control)

Crankcase Ventilation Systems prior to 1961 had no smog control. Combustion blow-by and raw fuel vapors were drawn out of the crankcase through the road draft tube and dumped into the atmosphere.

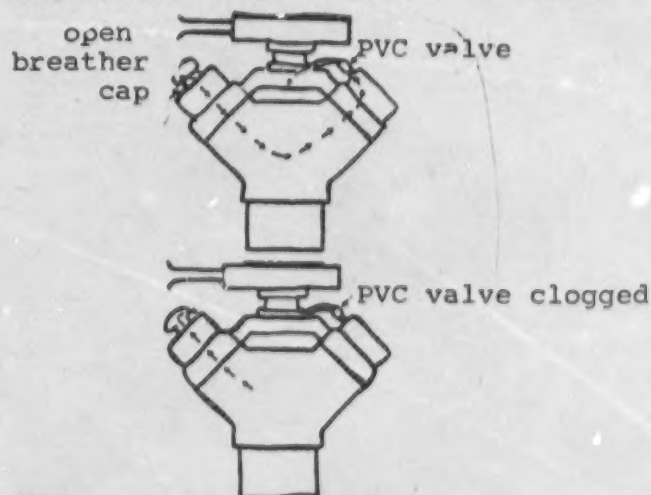
Figure 10

Group II (open PCV system)

This system is known as the Open Positive Crankcase Ventilation System. Air is drawn in through a conventional open breather cap and out of the crankcase through the PCV valve, through a connecting hose to the intake manifold and back into the combustion chambers for reburning. (Figure 11)

When the PCV valve becomes clogged, the crankcase pressure is exhausted through the breather cap to the atmosphere. Frequently, an excessive amount of engine oil (vaporized) is exhausted with other gases.

Figure 11



DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	4

INSTRUCTION SHEET

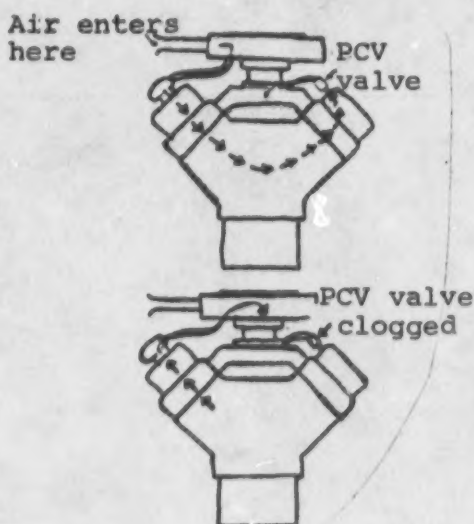
RVTC

PAGE 7 OF 14

Group III (closed PCV system)

This system is known as the closed system. Air is drawn from the clean side of the air cleaner through a connecting hose to a closed breather cap. It then goes through the crankcase, PCV valve and intake manifold to the combustion chambers of the engine where it is reburned.

Figure 12



When the PCV valve becomes clogged, the crankcase pressure forces the fumes through the closed breather cap, air cleaner and through the carburetor and into the engine where it is reburned. On the way through this circuit, it deposits residue onto the carburetor throttle valve and choke valve. This residue impairs their free operation. Deposits are also accumulated in the air bleed holes, causing a rich mixture at high speeds where it will rarely be noticed. Poor gas mileage and engine damage are quite common from this cause. Figure 12 shows how a PCV valve should work.

How a PCV Valve Functions

The function of a PCV valve is to meter the flow of engine blow-by and crankcase back into the combustion chambers of the engine for reburning. For normal operating conditions see Figure 13 on the following page.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	4

INSTRUCTION SHEET

RVTC

PAGE 8 OF 14

Figure 13A



Figure 13B

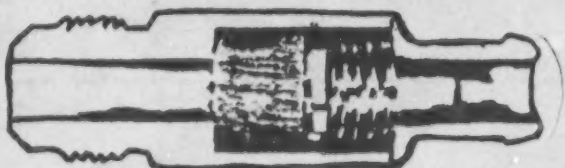
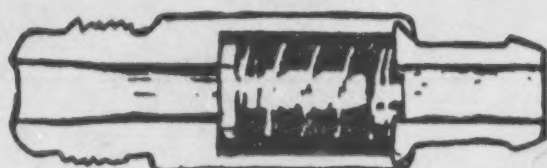


Figure 13C

Exhaust Emissions

Beginning January 1, 1968, federal regulations required all passenger cars and trucks up to 6,000 pounds gross weight to be equipped with an exhaust emissions system. This system limits the amount of unburned hydrocarbons and carbon monoxide emitted from the exhaust tailpipe. Since that date, limits have also been placed on emission of oxides of nitrogen.

Controlling exhaust gas emissions is complex, requiring two basic systems and various assist units to meet the emission control standards.

The first is an Engine Modification System in which greater combustion efficiency is achieved, thus leaving less unburned hydrocarbons and carbon monoxides in the exhaust.

The second is an Air Injection System in which air is forced into the exhaust causing reburning of the exhaust. This reduces the amount of unburned hydrocarbons.

A description of the operating principles of each type of system and vehicle using it is as follows:

A. Engine Modification System (Figure 14)

Used by: American Motors -- Engine Mod System
 Chrysler Corp. -- Cleaner Air System (CAS)
 Ford Motor Co. -- Improved Combustion System
 General Motors Corp. -- Controlled Combustion System CCS

This system is used in conjunction with modifications to engine design such as revised valve timing patterns, cylinder head gasket design and changes to combustion chamber configuration.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	4

INSTRUCTION SHEET

RVTC

PAGE 9 OF 14

A modified carburetor and distributor are used with a sensing vacuum control valve which varies the ignition timing to match varying conditions of engine operations. The carburetor is specially calibrated to provide leaner fuel mixtures for idle and low speed operation. The distributor is designed to provide a retarded ignition timing at idle speed and the vacuum advance control valve in conjunction with the distributor advances the ignition timing during deceleration.

Figure 14

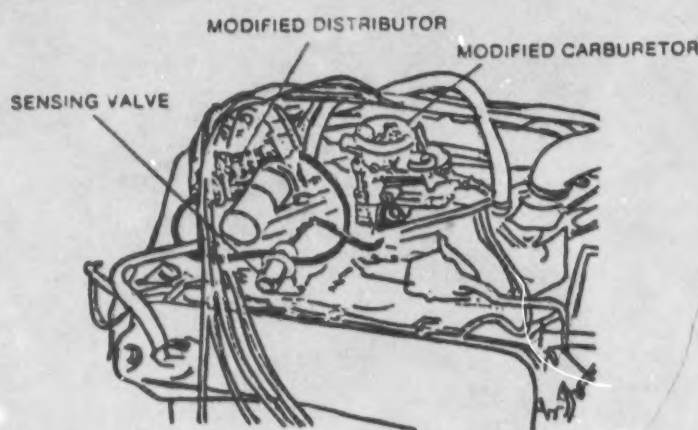
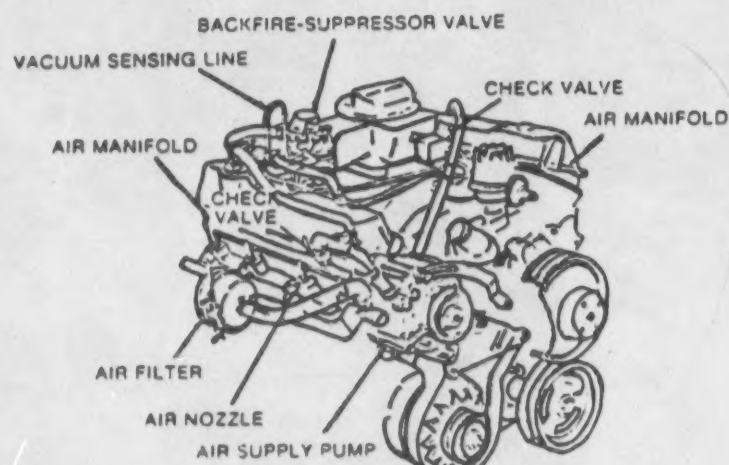


Figure 15



DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	4

INSTRUCTION SHEET

RVTC

PAGE 10 OF 14

B. Air Injection System (Figure 15)

Used by: American Motors -- Air Guard
 Ford Motor Co. -- Thermactor Emission (TE)
 General Motors Corp. -- Air Injection Reactor (AIR)
 Chrysler Corp. -- Air Injection System

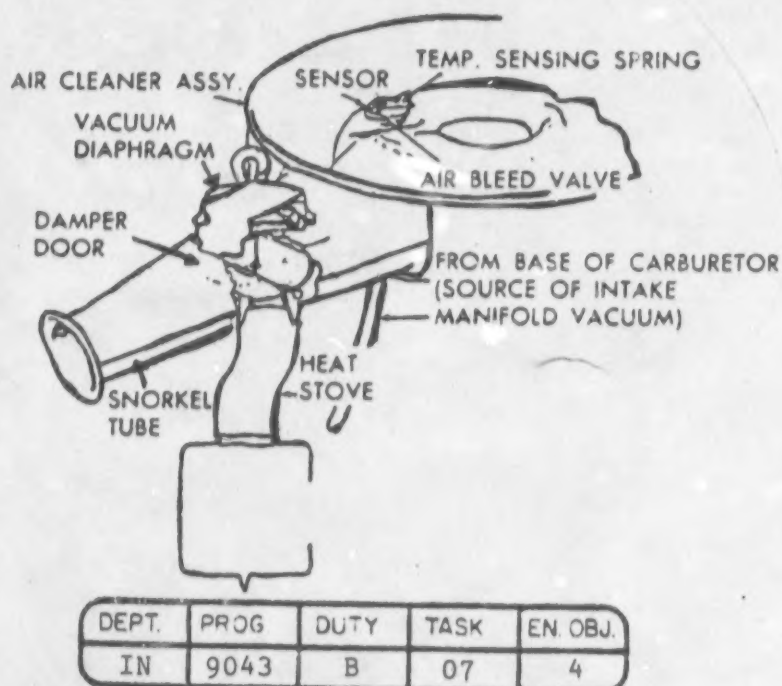
This system works on the principle of an after burner action. A belt driven, low pressure air pump forces air through hoses (or passages in the engine itself) to an air manifold. Air nozzles, leading to the exhaust valve in each cylinder, inject air directly into the exhaust gases. Normal operating temperatures at this point are high enough so any unburned hydrocarbons will automatically ignite and burn when mixed with the air supply. This burning in the exhaust manifold reduces the amount of unburned hydrocarbons in the exhaust.

Thermostatically Controlled Air Cleaners (Figure 16)

Hydrocarbon and carbon monoxide exhaust emissions are highest when the engine is cold and the choke is closed. Leaner carburetor settings are used to reduce these emissions. A leaner air/fuel mixture is effective only if the air is heated. To help control cold engine hydrocarbon and carbon monoxide exhaust emissions many air cleaners now are designed to control the temperature of the intake air to the carburetor.

Figure 16

THERMOSTATIC AIR CLEANER



INSTRUCTION SHEET

RVTC

PAGE 11 OF 14

Spark Controls

To reduce oxides of nitrogen exhaust emissions, spark controls are used to either retard or delay spark timing to reduce combustion temperature and pressure.

Exhaust Gas Recirculation

In addition to spark control, most automobile manufacturers also use an Exhaust Gas Recirculation (EGR) system to control oxides of nitrogen emissions. The EGR system does this by metering a small amount of exhaust gas into the intake manifold, which dilutes the fuel/air mixture. The diluted fuel/air mixture tends to slow down the combustion process, thus lowering peak combustion temperature.

Figure 17

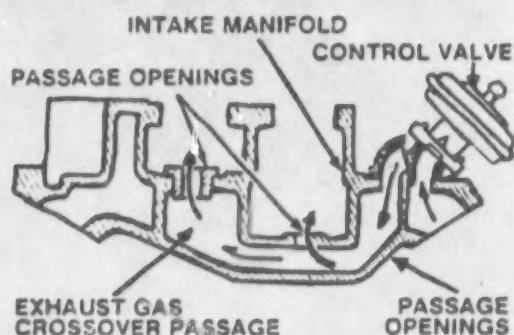
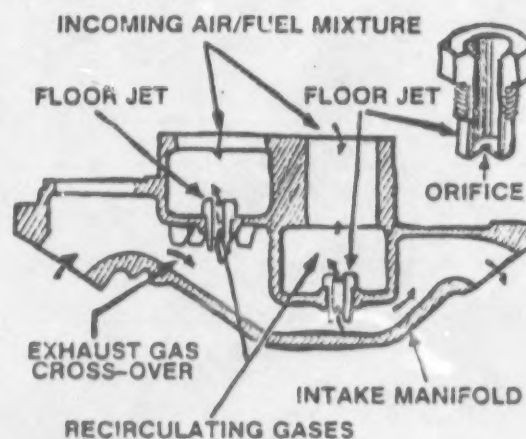


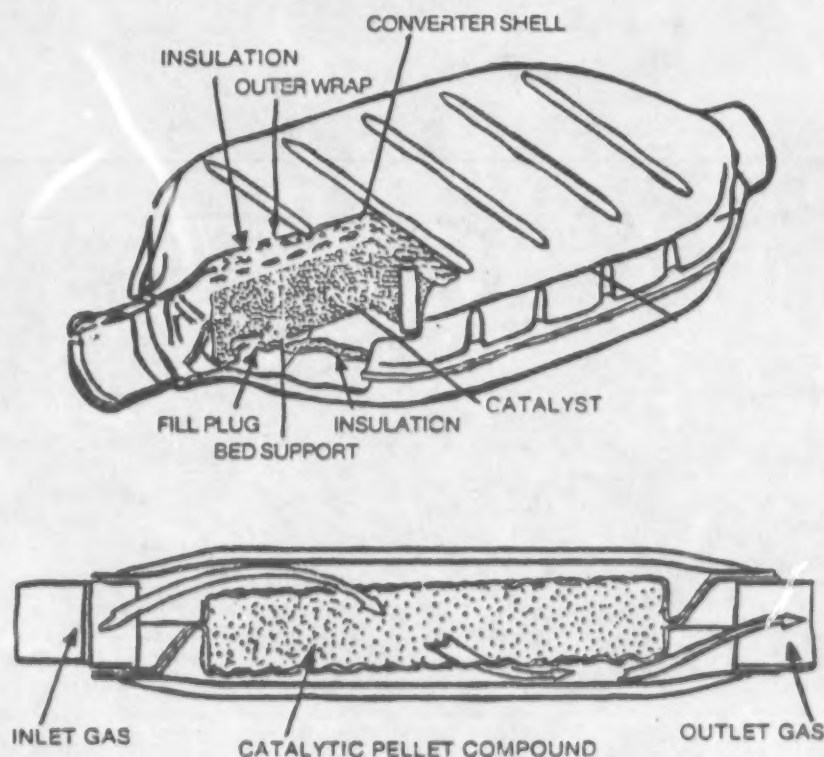
Figure 18



DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	4

Figure 19

UNDERFLOOR OXIDIZING CATALYTIC CONVERTER

Catalytic Converter (Figure 19)

Beginning with the 1975 model year, the catalytic converter was added to the exhaust emission control system by most manufacturers. The addition of the catalytic converter improved the control of hydrocarbon and carbon monoxide exhaust gas emissions. This made it possible to improve engine performance and economy. Although most of the exhaust emission control system devices used prior to 1975 were retained, the addition of the catalytic converter allowed the carburetor to be recalibrated and spark advance to be increased for improved engine performance and fuel economy.

DEPT.	PROG.	DUTY	TASK	EN OBJ.
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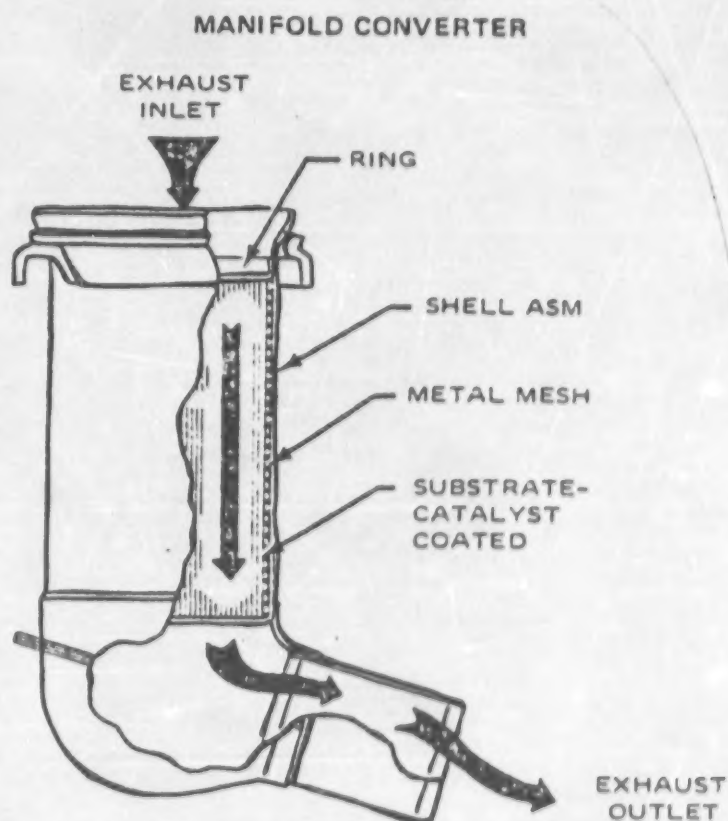
INSTRUCTION SHEET

RVTC

PAGE 13 OF 14

On some vehicles, and underfloor catalytic converter is used. This device is located between the exhaust manifold and the muffler. (Figure 19) On other model vehicles, the catalytic converter is incorporated in the exhaust manifold. (Figure 20)

Figure 20



DEPT	PROG	DUTY	TASK	EN OBJ.
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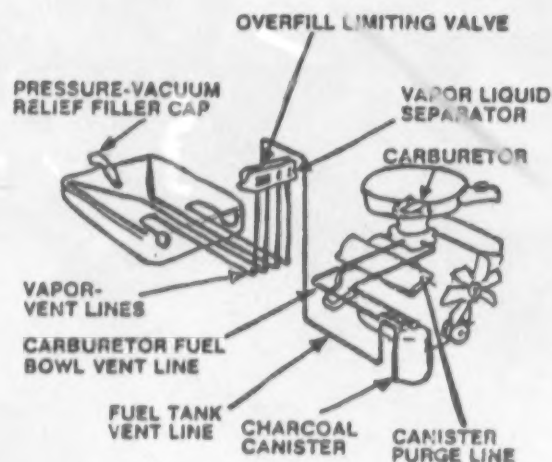
INSTRUCTION SHEET

RVTC

PAGE 14 OF 14Fuel Evaporation Emission Control System (Figure 21)

The Fuel Evaporation Emission Control System, standard on all American made cars built since 1971, is designed to prevent fuel vapors from the fuel tank and carburetor from escaping into the atmosphere. When the engine is running, the fuel vapor is drawn into the carburetor, where it mixes with the fuel and is burned during combustion. When the engine is stopped, the fuel vapor is stored in an activated charcoal filled canister, located in the engine compartment. When the engine is started, the manifold vacuum draws the stored vapors from the canister into the carburetor.

Figure 21



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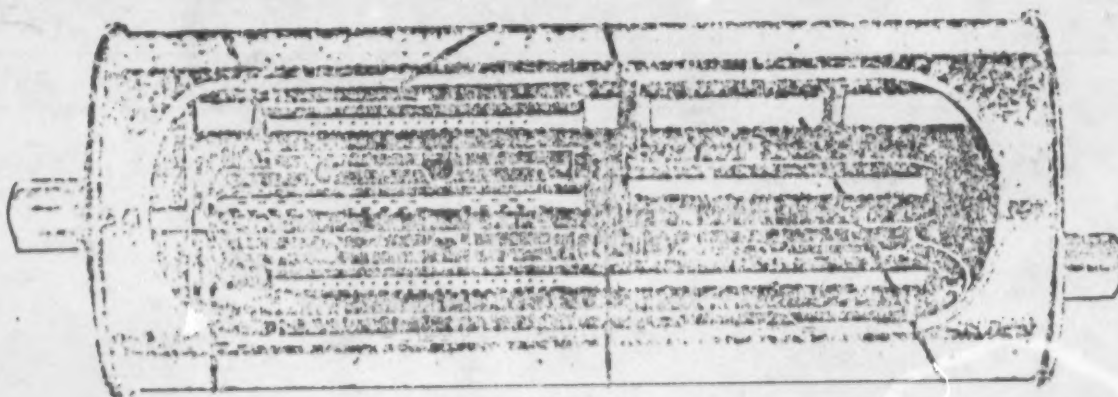
SELF-CHECK

RVTC

Directions

Evaluate your knowledge by identifying the items below on a separate sheet of paper.

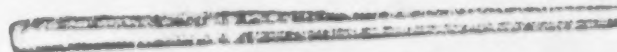
1.



2.



3.



4.



DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	4

SELF-CHECK

RVTC

5.



6.



7.



8.



9.



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	4

SELF-CHECK

RVTC

Answer Key

1. muffler
2. resonator
3. intermediate pipe
4. tailpipe
5. exhaust manifold
6. "Y" or crossover pipe
7. "H" pipe
8. holders
9. clamp

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	4

ENABLING OBJECTIVE NO. 5
RVTC

Identify engine block assembly, valve train, seal and gasket components.

LEARNING STEPS

1. Read Resource No. 1 to identify some of the most common engine parts and their purpose.
2. Evaluate your knowledge by completing the Self-Check.
3. Instructor will provide a demonstration on engine construction.
4. When you think you attain this task, take the Written Test.
5. When you successfully complete the Written Test, take the Performance Test.

RESOURCES

1. Instruction Sheet enclosed, Engine Construction
2. Self-Check enclosed.
3. a. Instructor
b. Vehicle
4. Written Test for task B-07.
5. Performance Test for task B-07.

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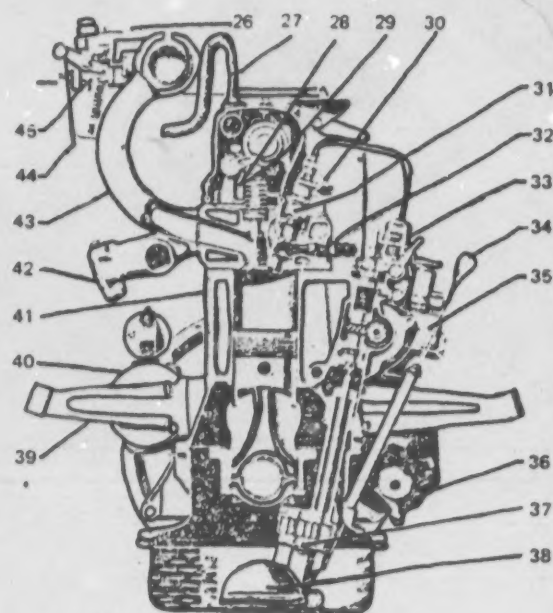
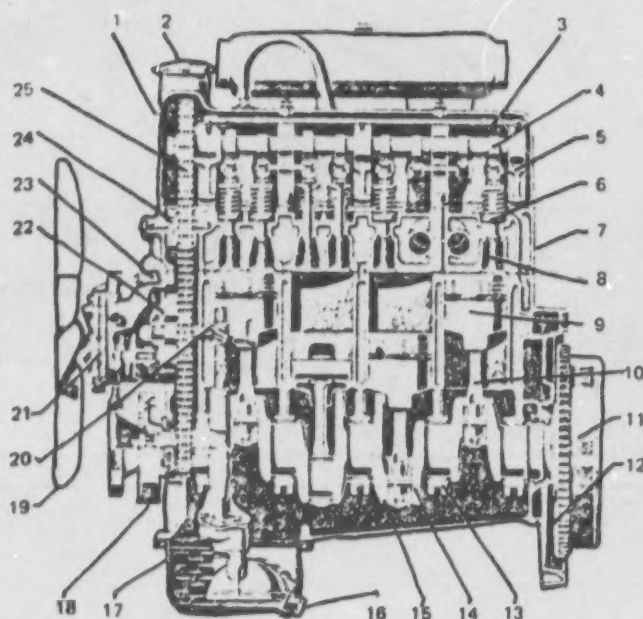
INSTRUCTION SHEET

RVTC

PAGE 1 OF 22

Engine Construction

The modern automobile engine is divided into four major categories: Cylinder Block Assembly, Valve Train Assembly, Lubrication System and Gaskets and Oil Seats.



- 1 CYLINDER HEAD COVER
- 2 OIL FILLER NECK
- 3 OIL PIPE (CAMSHAFT LUBRICATION)
- 4 CAMSHAFT
- 5 CAMSHAFT BEARING
- 6 ROTOCAP (VALVE TURNING DEVICE)
- 7 CYLINDER HEAD
- 8 EXHAUST VALVE
- 9 PISTON
- 10 CONNECTING ROD
- 11 FLYWHEEL
- 12 INTERMEDIATE FLANGE
- 13 CRANKSHAFT BEARING COVER
- 14 CRANKSHAFT
- 15 OIL SUMP UPPER PART
- 16 OIL DRAIN PLUG

- 17 OIL SUMP, LOWER PART
- 18 COUNTERWEIGHT
- 19 FAN
- 20 DRIVE SHAFT (INJECTION PUMP-OIL PUMP)
- 21 VACUUM PUMP
- 22 INJECTION TIMER
- 23 WATER PUMP
- 24 TIMING CHAIN SPROCKET BEARING
- 25 DOUBLE ROLLER CHAIN
- 26 VACUUM LINE
- 27 BREATHER LINE
- 28 ROCKER ARM
- 29 ROCKER ARM SUPPORT
- 30 FUEL OVERFLOW LINE

- 31 INJECTION NOZZLE
- 32 GLOW PLUG
- 33 INJECTION PUMP
- 34 OIL DIPSTICK
- 35 FUEL FEED PUMP
- 36 OIL FILTER
- 37 OIL PUMP
- 38 STRAINER
- 39 ENGINE BRACKET
- 40 STARTER
- 41 CYLINDER CRANKCASE
- 42 EXHAUST MANIFOLD
- 43 IN MANIFOLD
- 44 CONTROL LINKAGE
- 45 MIXTURE CONTROLLER

DEPT	PROG	DUTY	TASK	EN OBJ
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

 PAGE 2 OF 22

Cylinder Block Assembly

The cylinders and all internal engine parts are housed in a piece of cast metal called a cylinder block. In almost all passenger car and light truck engines, the walls of the cylinder are formed by the cast iron block itself (Figure 2). Cast iron is an excellent bearing surface and wears very slowly under reasonably clean operating conditions.

When excessive wear does occur, the cylinders can be bored oversize to accomodate oversize pistons and rings. Normal industry oversizes for passenger cars and light trucks are .030", .040" and .060".

Figure 2 CYLINDER BORE

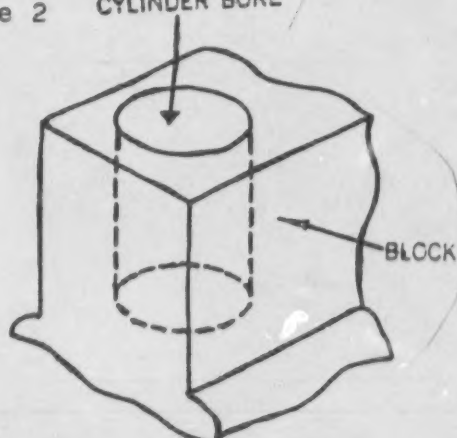
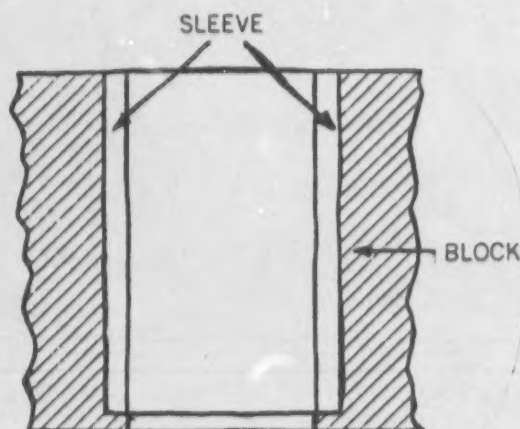


Figure 3



Repair Cylinder Sleeve

Cylinder bores that are worn beyond allowable re-ring limits, or deeply scored or damaged, may be repaired by boring them to accomodate flangeless cast iron repair sleeves (Figure 3).

Dry and Wet Cylinder Sleeves

Many truck and tractor engines are made with flanged dry or wet cylinder sleeves. Instead of boring cylinders in these engines when the cylinders become worn, the old sleeve and piston assemblies are discarded and new ones installed. The outer surfaces of dry sleeves do not come into contact with the engine coolant, but form a liner inside of the block itself (Figure 4). The outer surfaces of wet cylinder sleeves are exposed to the engine coolant (Figure 5). Rubber "O" rings in grooves in the lower part of the sleeve or block prevent coolant from leaking into the crankcase.

DEPT.	PROG	DUTY	TASK	EN OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

PAGE 3 OF 22

Figure 4

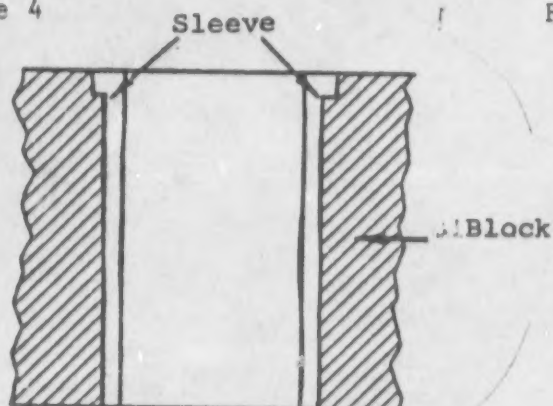
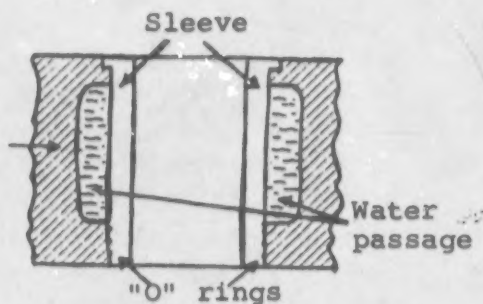


Figure 5

Replaceable Finned Cylinders

These replaceable cylinders are used on air-cooled engines, and the units bolt directly onto the crankcase (Figure 6). The cylinders are cooled by air passing over the cylinder fins rather than by water circulating through the block. When excessive wear occurs in these cylinders, they are discarded and new standard cylinders and piston and ring assemblies are installed.

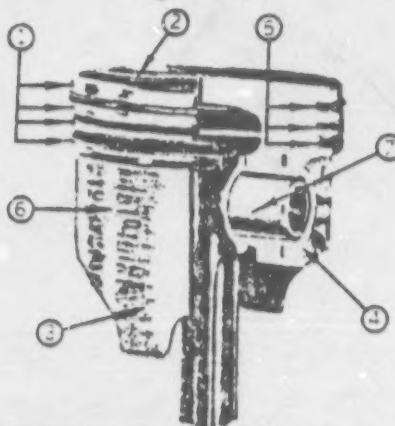
Pistons

The piston receives the force of the combustion in the engine and transmits this force to the crankshaft through the connecting rod. Pistons for older engines were generally made from cast iron, but almost all pistons used in today's engines are made from aluminum alloy.

Figure 6



Figure 7



1. lands
2. head
3. skirt
4. pin boss
5. ring grooves
6. thrust face
7. pin

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

PAGE 4 OF 22

Piston Pin

The piston pin joins the piston and connecting rods (Figure 7). In most passenger cars and light truck engines, the pins are press-fit in connecting rod eye and float only in the piston. In some engines, the pins float in both the piston and connecting rod eye. Full floating pins are kept in place by lockrings in a groove at the end of each piston pin hole.

Piston pins are sold with new pistons, but may also be purchased separately. Replacement piston pins are generally available in .0015", .003", .005" and .010" oversize.

Piston Rings

Piston rings form a gas-tight seal between the piston and cylinder and prevent excess oil from passing from the crankcase to the combustion chamber. They fit into precisely cut grooves in the upper portion of the piston.

Compression rings, as the name implies, form the gas seal between the combustion chamber and the crankcase.

Oil rings are designed to scrape most of the oil down into the crankcase, but yet leave a very thin oil film on the cylinder wall so the compression rings receive lubrication. Most passenger car and light truck pistons have one oil ring, it is located below the two compression rings.

Connecting Rods

The connecting rods, as the name indicates, is a rod that connects the piston and crankshaft. Its purpose is to change the up and down motion of the piston at the top end of the connecting rod to a revolving motion of the crankshaft at the bottom end of the rod (Figure 8).

The top end is called the eye or small end and is connected to the piston by the piston pin, sometimes called a wrist pin. This small end may or may not also require a bronze bushing. This end of the connecting rod will have a slight back and forth motion as the piston and connecting rod move up and down.

The bottom end of the rod must be split so that it can be installed on the crankshaft. This split allows the rod to separate into two pieces (lower is called rod cap) so that it can be bolted around the crankshaft rod journal. When the crankshaft is turning, it revolves inside of the big end of the rod. As the connecting rod moves up and down, the big end of the rod forces the crankshaft to turn.

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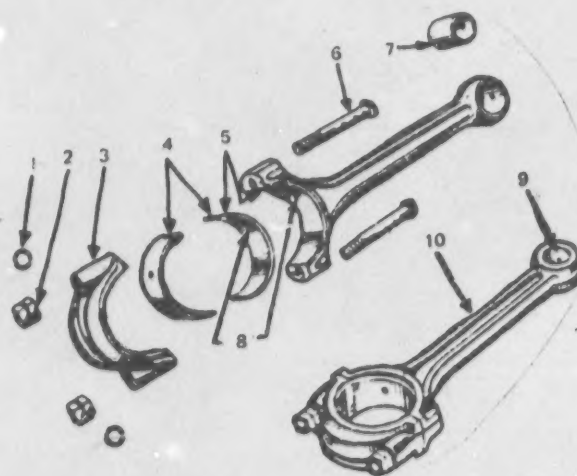
INSTRUCTION SHEET

RVTC

PAGE 5 OF 22

Figure 8

1. cap-bolt-nut lock washer
2. cap-bolt nut
3. cap
4. rod bearings
5. tongue and groove
6. cap bolt
7. piston-pin bearing
8. oilholes
9. oilhole
10. assembled rod



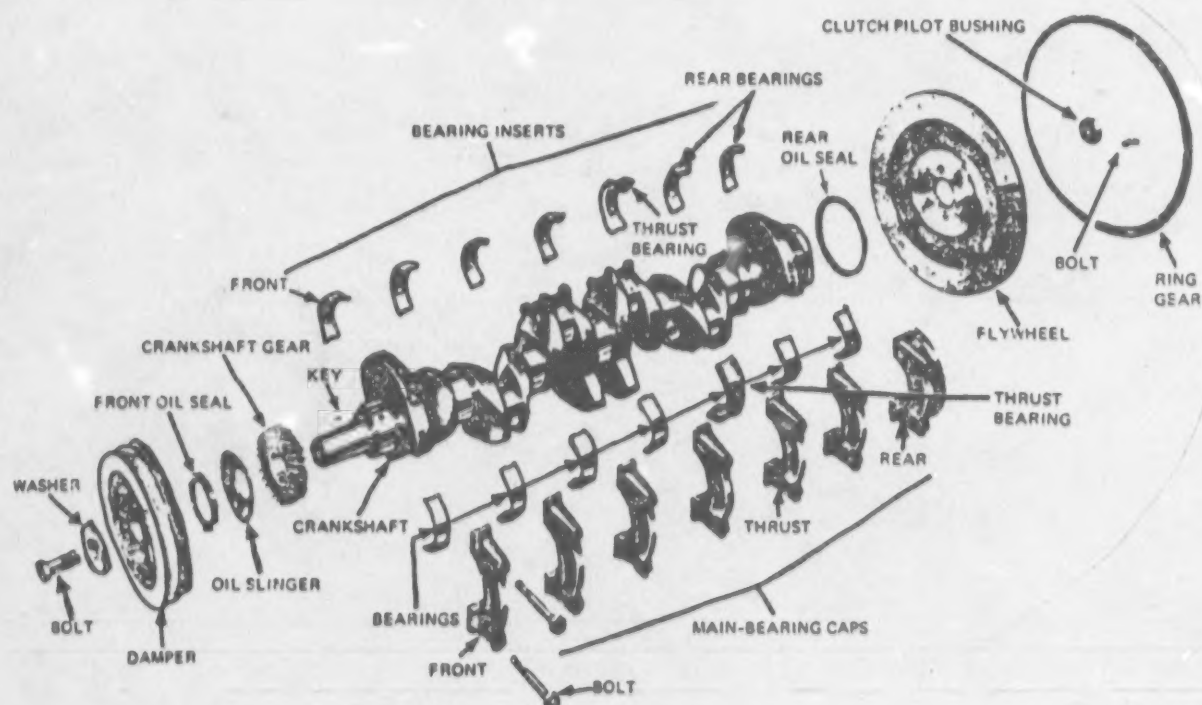
DEPT	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

PAGE 6 OF 22

Figure 9

Crankshafts

The crankshaft (Figure 9), which is attached to the connecting rod, changes the up and down motion of the rod to a revolving or a rotating motion. This is the motion that is used to move the car. This motion is also used to drive the power accessories such as oil, water and fuel pumps, generator, alternator, fan distributor, power steering and brakes, flywheel, timing chain or gear and compressors.

The maintenance and causes for failure of crankshafts and mating parts are the same as those previously mentioned for connecting rods.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

PAGE 7 OF 22Bearings

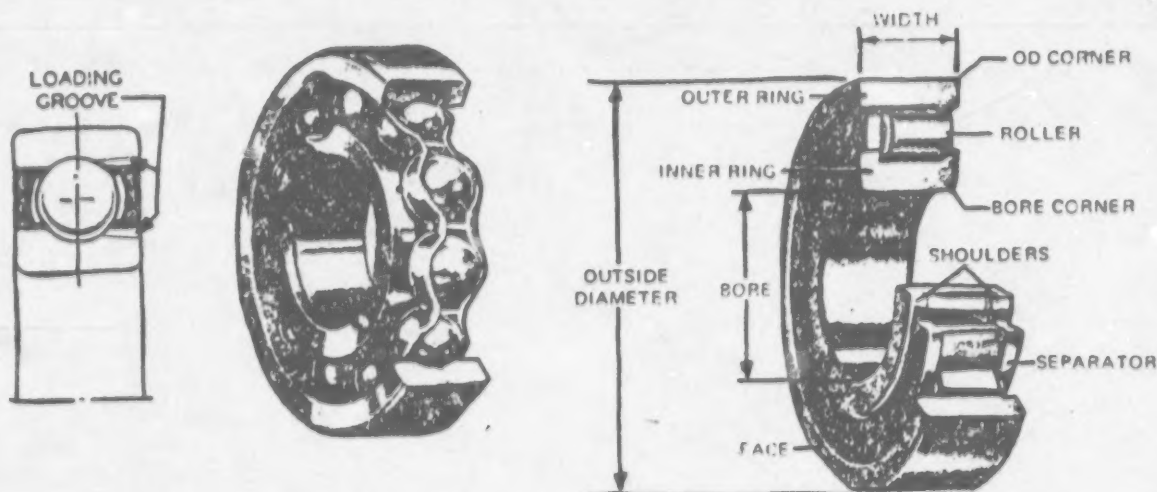
An engine bearing is a device used to hold a revolving or rotating part in place. Its purpose is to protect the more expensive crankshaft, carry the loads of the engine and provide a low friction surface for the rotating part (Figure 10).

For lubrication purposes, most bearings have oil hoses and grooves.

The main causes of bearing failure are misalignment, misassembly, insufficient lubrication, overloading, corrosion, dirt and normal wear from extended use and mating parts not to the proper specifications. The biggest single cause of bearing failure is dirt. Dirt is broadly defined to mean any foreign object that enters the oil.

Since dirt is the biggest single cause of bearing failure, extended bearing life can be obtained by removing the dirt particles through regular oil changes, replacement of oil and air filters and by cleaning the breather cap and PCV system.

Figure 10



DEPT.	PROG.	DUTY	TASK	EN OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

PAGE 8 OF 22

Flywheel

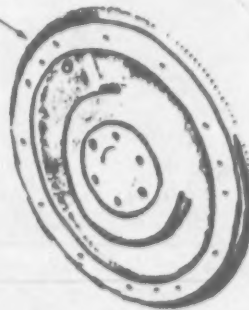
The flywheel is a large metal disc that is bolted and doweled to the rear of the crankshaft (Figure 11).

Attached to the outer rim of the flywheel is a steel ring, which has gear teeth cut into it on the outside diameter. When the ignition key is turned, the starter motor gear engages these teeth and spins the flywheel to crank the engine.

The purpose of the flywheel is to keep the crankshaft spinning between power strokes and to smooth out the engine speed.

Figure 11

FLYWHEEL



Valve Train System

The incoming fuel charge enters the combustion chamber of the cylinder through the intake valve and the burned exhaust gases leave through the exhaust valve. The valve train system that activates the valves can be different in some engines. The most common valve train configuration is the overhead valve system used in almost all of today's engines. This is shown in Figure 12 on the following page.

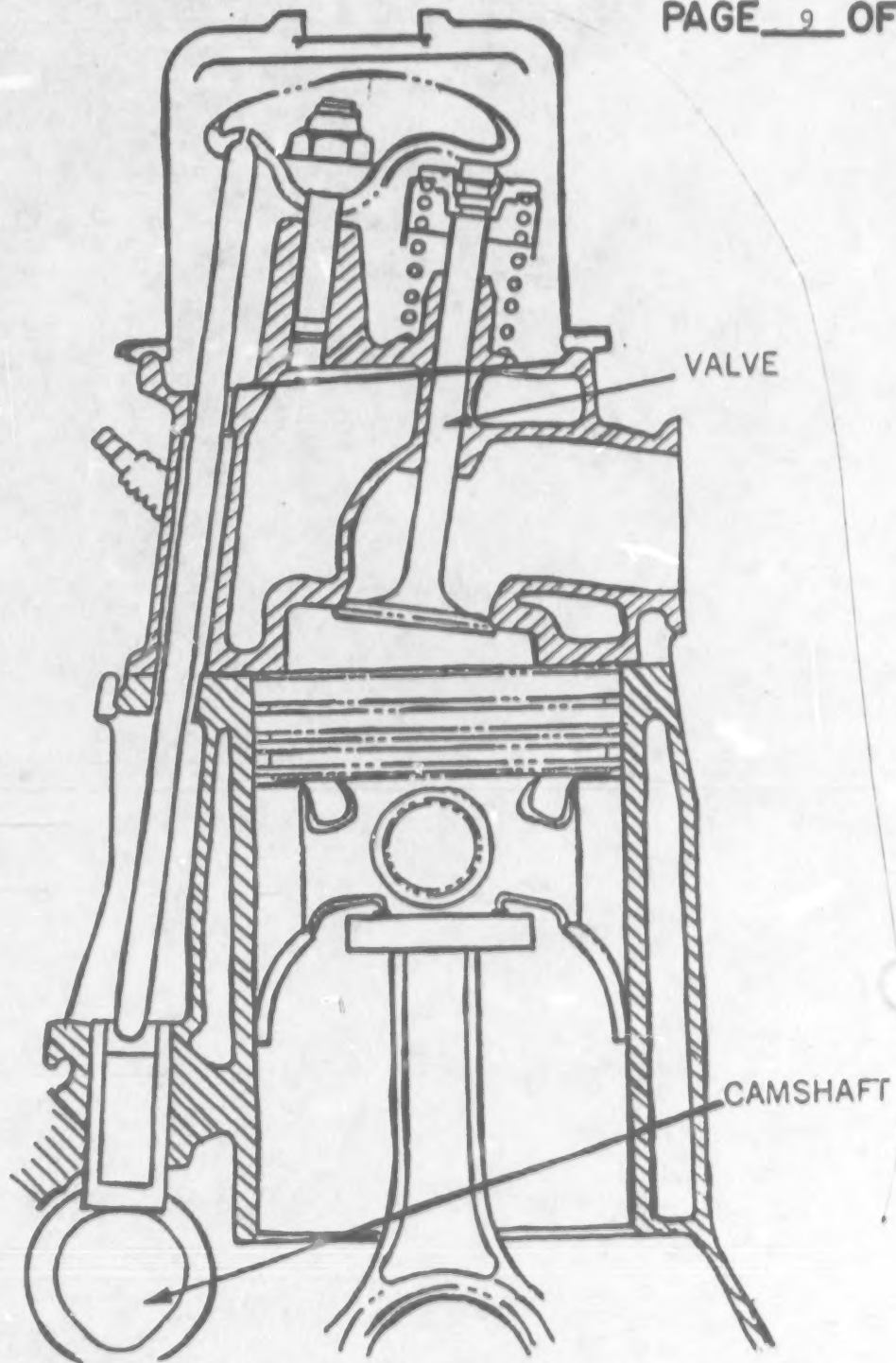
DEPT.	PROG	DUTY	TASK	EN OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

PAGE 9 OF 22

Figure 12



DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

 PAGE 10 OF 22

Valve Timing

In order for the engine to function properly, the intake and exhaust valves must open and close within very precise time limits. These time limits are dependent upon the position of the pistons in their cylinders. To accomplish these very precise valve movements, the camshaft is driven by the crankshaft through timing gears or a chain and sprockets. The timing gear system consists of a helical camshaft gear and a mating crankshaft gear (Figure 13).

Figure 13

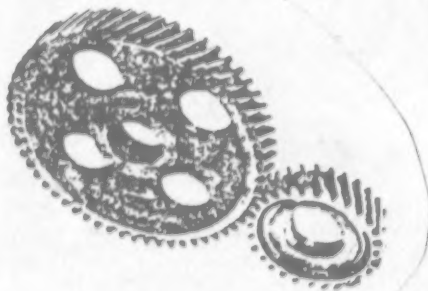
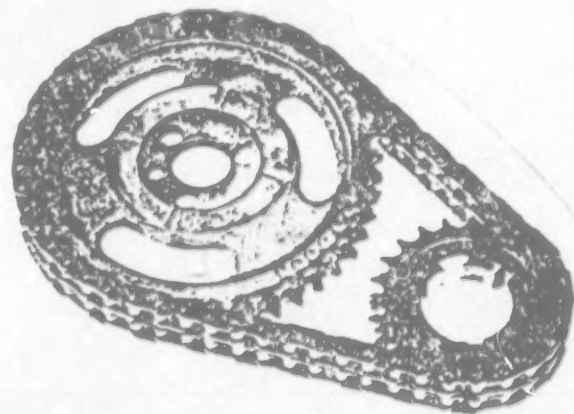


Figure 14



The chain and sprocket system consists of a spur type camshaft sprocket and a crankshaft sprocket. Both of these are connected by an endless timing chain. The chain is either a silent inverted tooth or roller type (Figure 14).

The timing gears, or chain and sprockets, directly connect the rotation of the crankshaft to the camshaft. Thus activating the camshaft with a predetermined speed of two revolutions of the camshaft to one rotation of the crankshaft (this applies to all 4-cycle engines). This establishes proper valve opening and closing in synchronization with the piston action controlled by the crankshaft.

Timing gear and timing chain

The crankshaft gear when installed mates with the camshaft gear.

The timing chain rolls over the two sprockets and controls the operation of each sprocket. In each case, there are timing marks on the gears or sprockets. These are designed to establish proper synchronization of camshaft and crankshaft (Figure 15 on the following page).

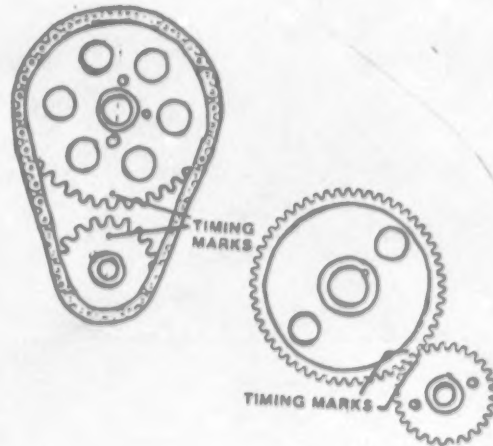
DEPT.	PROG	DUTY	TASK	EN OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

PAGE 11 OF 22

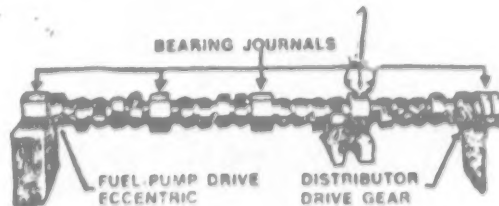
Figure 15

Camshafts

Camshafts for passenger car and light truck engines usually have one intake and one exhaust cam for each cylinder (Figure 16), to activate the valve train and open the valves at the proper time.

The camshaft on a four cycle engine is driven by gears, or sprockets and chains, from the crankshaft at one-half crankshaft speed. This allows each valve to open and shut every second revolution of the crank. Camshafts may also drive the fuel pump, oil pump and distributor.

Figure 16



DEPT.	PROG	DUTY	TASK	EN OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

PAGE 12 OF 22

Valve lifter or tappet

As each camshaft lobe rotates it raises the valve lifter, which in turn activates the rest of the valve train (Figure 17). The two types of valve lifters used are mechanical and hydraulic.

Mechanical valve lifters generally consist of a hollow body with a push rod seat fitted at the top. This hollow construction provides less reciprocating weight than would a solid lifter. An adjustment screw on the rocker arm allows the mechanic to establish a pre-determined valve system clearance or lash to prevent expansion from holding a valve slightly open when it should be closed.

Most of today's passenger cars use hydraulic valve lifters (Figure 18). Oil and under pressure are stored in the hydraulic valve lifter's lower chamber. This allows the lifter to adjust to the expansion of a heated valve, eliminating the necessity of clearance or lash in the valve train. The resulting zero valve clearance in a system with hydraulic lifters reduces valve train noises.

Figure 17

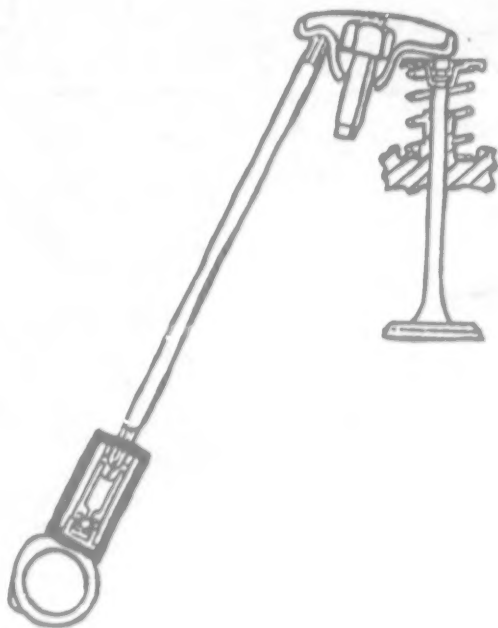
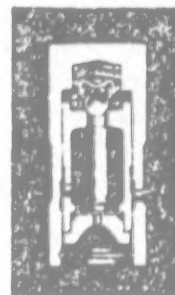


Figure 18



DEPT	PROG	DUTY	TASK	EN OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

PAGE 13 OF 22

Figure 19

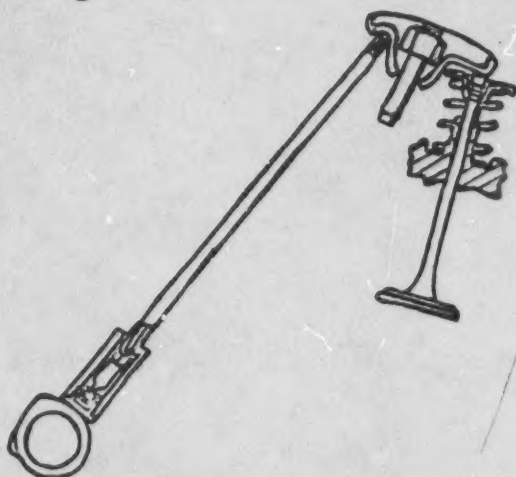


Figure 20

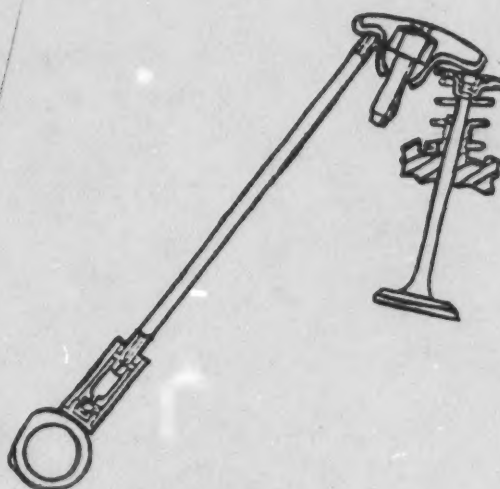
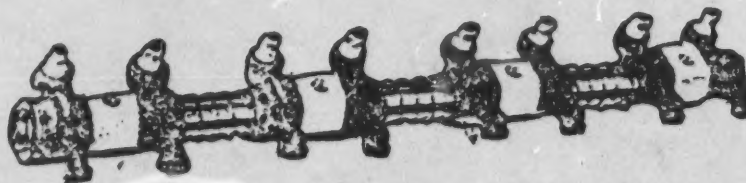


Figure 21

Push rods

The next component in an overhead valve system is the push rod (Figure 19). It fits between the valve lifter and rocker arm to help transmit cam action to the valves. Some push rods also function as a part of the lubricating system for the rocker arm assembly. Oil flows under pressure from the block through the valve lifter and up through the push rod to the rocker arm.

Push rods that are bent or have worn tips must be replaced with new ones.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

PAGE 14 OF 22

Rocker arms and parts

The rocker arm transmits the upward motion of the valve lifter and push rod to a downward motion (opening) of the valve.

On early overhead valve engines, the rocker arms were assembled to a rocker arm shaft (Figures 20 and 21) that was mounted on the head by rocker arm brackets.

Valve springs and valve spring shims

The function of the valve spring is to close the valve and keep it closed and seated until opened by the camshaft (Figure 22). A single valve spring on each valve has been used by most manufacturers, but double valve springs or springs with inner dampeners are now used on many engines to reduce spring vibration and valve flutter (Figure 23).

Figure 22

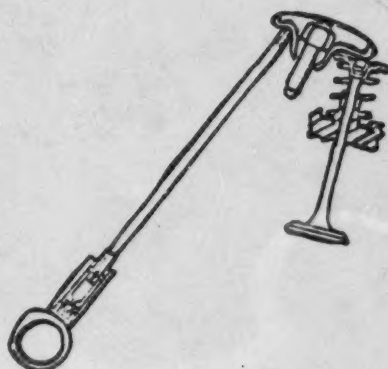


Figure 23



After a valve spring has been in operation for a period of time, spring tension is reduced. If this is not corrected when the engine is down for a valve grind or overhaul, peak performance will not be obtained. New valve springs should always be installed. In addition, if the assembled valve height is increased due to grinding the valve seat. Appropriate valve spring shims must be installed below the valve spring to restore the original dimension from the seat in the head to the spring retainer (Figure 24).

DEPT.	PROG	DUTY	TASK	EN OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

PAGE 15 OF 22

Figure 24

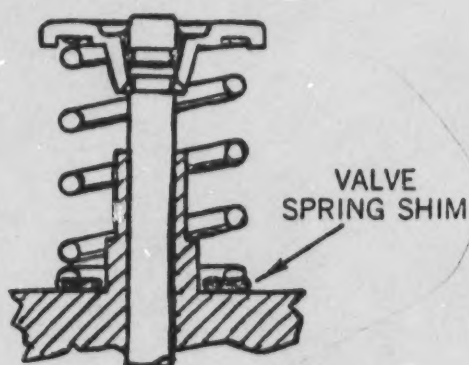
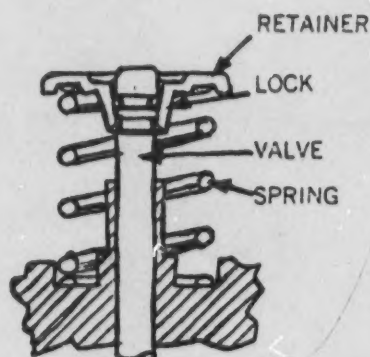


Figure 25

Valve spring retainers and locks

The spring retainer fits over the upper end of the valve spring and the assembly is held in place on the valve stem by valve locks (Figure 25). Other names often used for valve locks are keepers or keys. Different engine manufacturers may use different shaped locks (Figure 26), but they all serve the same function. Spring retainers seldom require replacement. However, valve locks wear and it is good insurance to replace them to help prevent the loss of a valve during operation.

Figure 26



DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

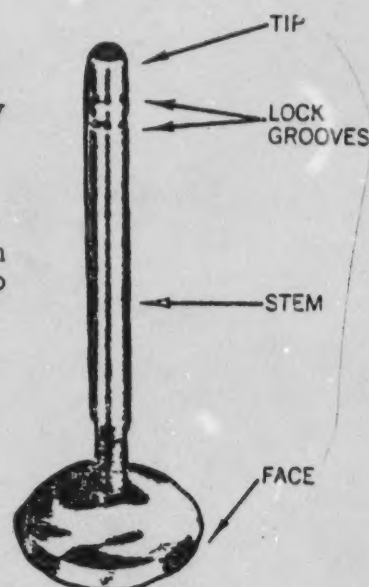
PAGE 16 OF 22

Valves

One intake and one exhaust valve is ordinarily used for each cylinder in a 4-cycle engine. However, some racing engines have two intake and two exhaust valves per cylinder.

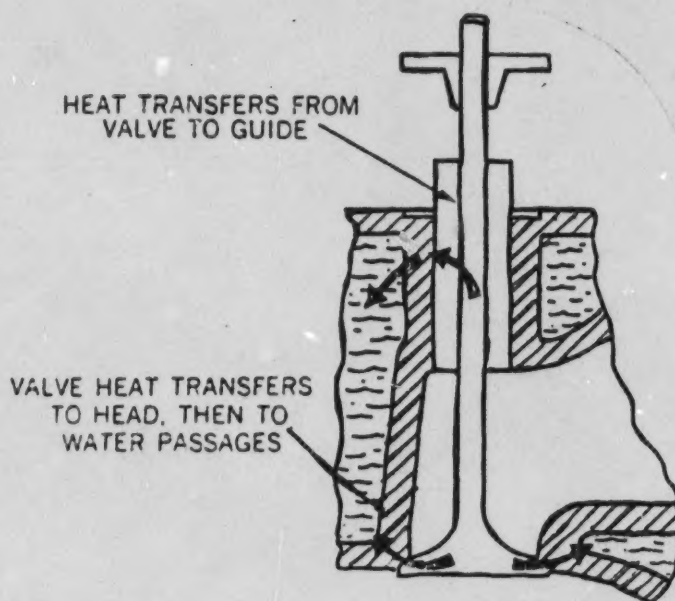
The intake valve opens every second revolution of the crankshaft to allow the fuel mixture to enter the combustion chamber. The exhaust valve opens at the end of the power stroke so burned gases can be exhausted.

Figure 27 shows the various parts of a valve.

Valve guides

As the name implies, these are machined passages in the cylinder head to accurately guide the valve stem (Figure 28). Heat is also transferred from the valve stem to the guide and cylinder head to cool the valve.

Figure 28



DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

PAGE 17 OF 22

The two common types of valve guides are the replaceable guide and the integral guide (Figure 29). Replaceable guides can be removed and replaced when they become worn. Integral guides are cast in the cylinder head. If worn slightly, they can be reamed oversize to accommodate an oversize valve stem. Badly worn integral valve guides are bored out so that a replaceable repair guide can be installed.

Figure 29

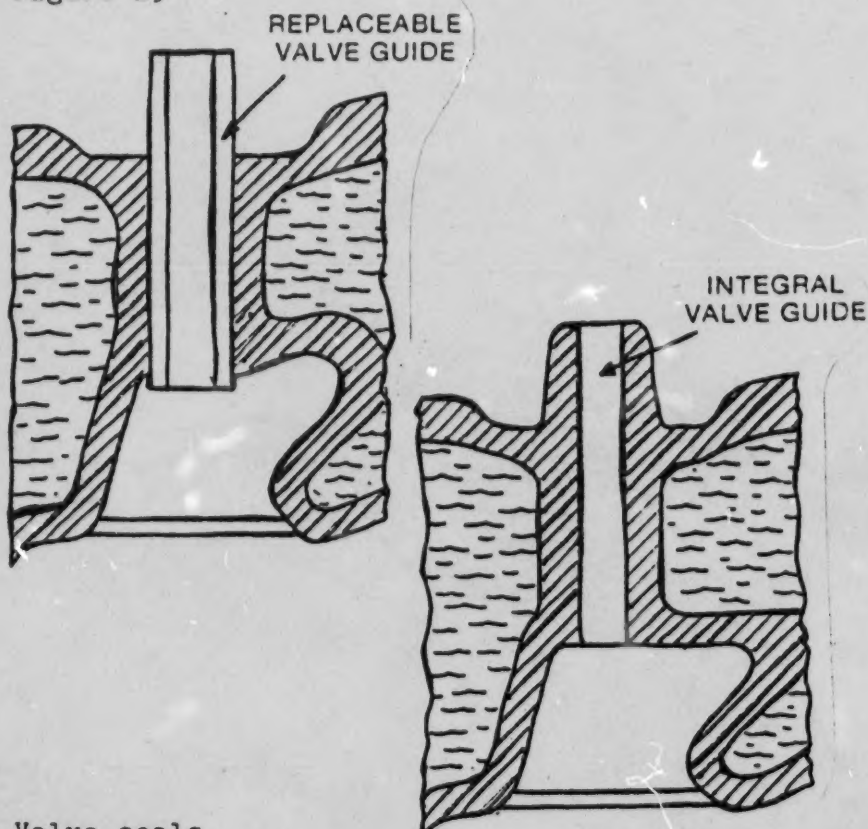
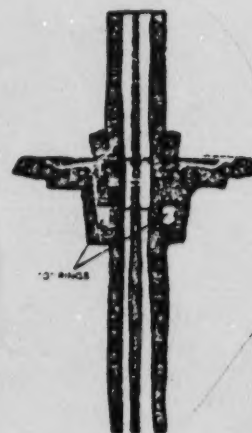


Figure 30

Valve seals

A great amount of oil is supplied to the valve and rocker arm area of an overhead valve engine to lubricate and to cool the parts. Much oil can be drawn down through the valve guides and lost if valve stem seals are not used.

Some seals are in the form of an "O" ring and fit in the lower valve stem groove as shown in Figure 30. This prevents the oil that has collected in the spring retainer from running down the valve stem.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

PAGE 18 OF 22

Another type is a rubber "umbrella" that fits on the valve stem (Figure 31) and prevents excess oil from being sprayed onto the valve stem.

Still another type is the positive valve seal shown in Figure 32. The rubber portion of the seal fits tightly on the valve guide, while the Teflon sealing member allows just enough oil to remain on the valve for lubrication and scrapes the excess off.

New valve seals must be installed whenever the valve train is assembled or disassembled.

Figure 31



Figure 32

Valve seats

The valve seat is located in the cylinder head of overhead valve engines (Figure 33), and forms a seal with the valve face when the valve is closed. The mating of these surfaces is critical.

Exhaust manifold and heat riser valve

Burned gases forced from the cylinders past the open exhaust valves travel through a cast iron exhaust manifold to the pipes and mufflers. Located at the outlet of one side of the exhaust manifold (generally the right side) is the heat riser valve (Figure 34). It improves engine performance during warm-up.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

PAGE 19 OF 22

Figure 33

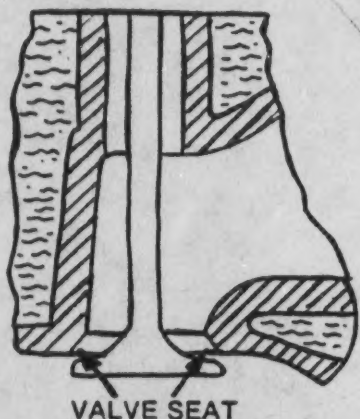


Figure 34

Lubrication system

The most important single system in the operation of an automobile is one you don't see -- the lubrication system. Without lubrication, the life span of an engine will be measured in minutes, not in thousands of miles, because friction will destroy the moving parts.

Today's high performance engines, with clearances between moving parts measured in thousandths of an inch, depend entirely upon the strength of a film of clean oil. This oil film, composed of tiny molecules, acts like microscopic ball bearings to prevent direct contact between moving parts by affording slippery surfaces that permit high speed operation hour after hour.

The engine lubrication system constantly provides an abundance of oil for every moving part in the engine. Figure 35 on the following page shows a typical lubrication system.

Oil is drawn from the crankcase through a strainer and is forced under pressure into the main gallery by the oil pump. As the speed of the engine increases the output pressure of the pump is also increased.

DEPT.	PROG	DUTY	TASK	EN OBJ.
IN	9043	B	07	5

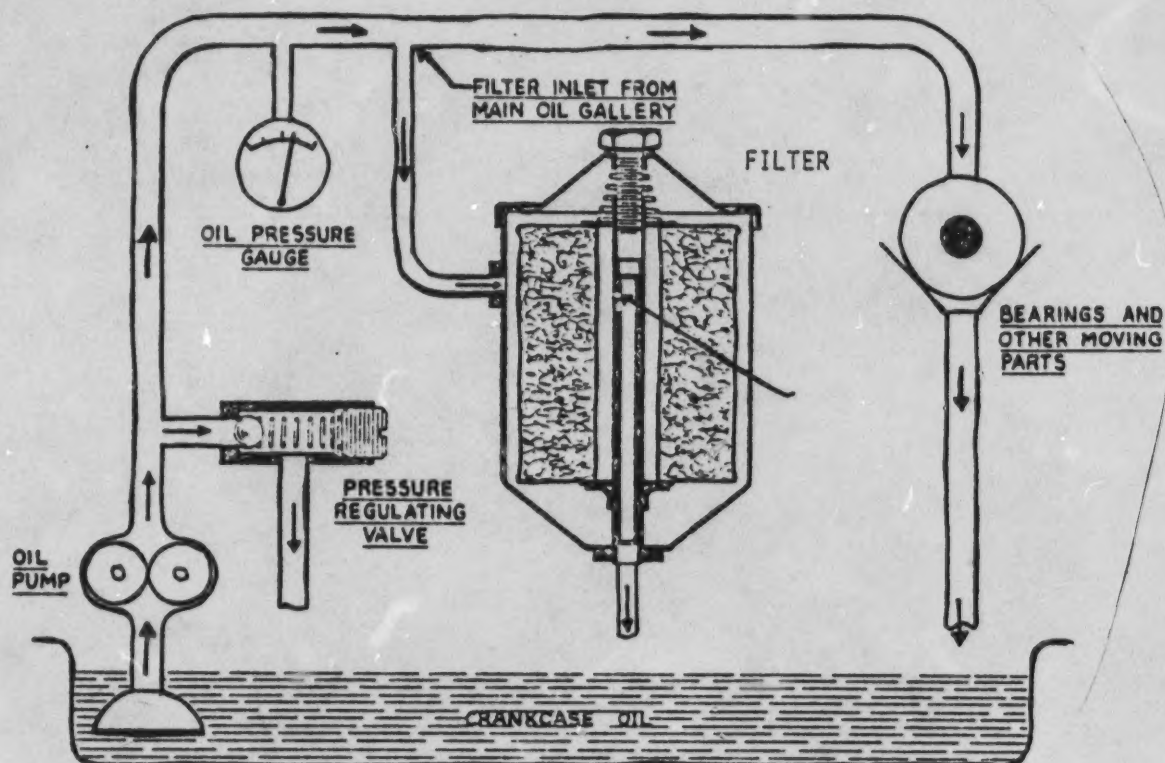
INSTRUCTION SHEET

RVTC

PAGE 20 OF 22

Figure 35

BY-PASS OIL FILTRATION SYSTEM



Lubricating oil pressure is controlled by a mechanism called the pressure regulating valve.

Oil filtration system

Clean lubricating oil is essential for long and trouble free engine life. The oil filtration system is second only to the lubricating system in order of importance.

Gaskets and oil seals

Gaskets are used between certain surfaces in an engine to prevent the leakage of oil, water and gases (Figure 36).

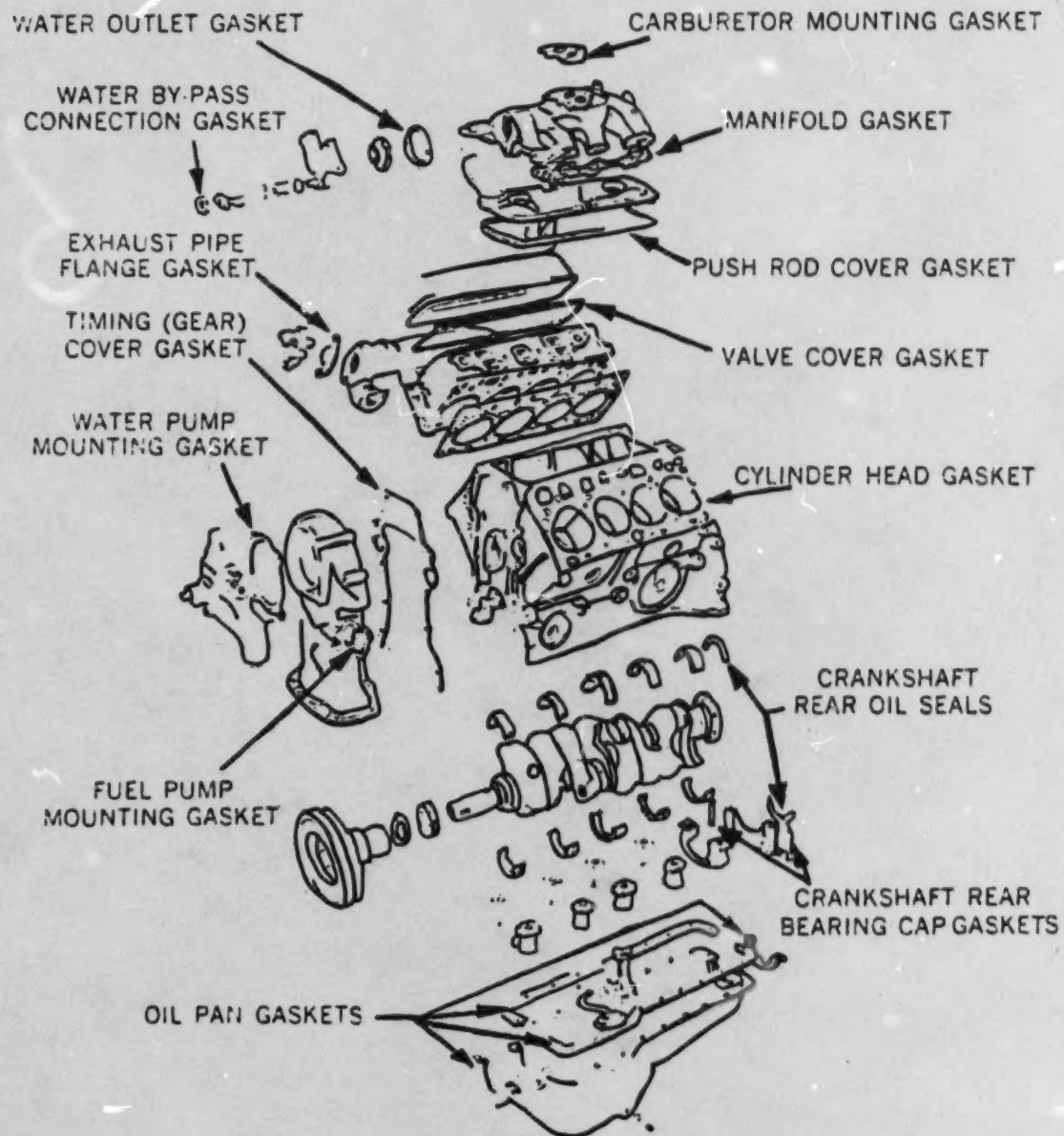
DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	5

INSTRUCTION SHEET

RVTC

PAGE 21 OF 22

Figure 36



DEPT.	PROG.	DUTY	TASK	EN OBJ.
IN	9043	B	07	5

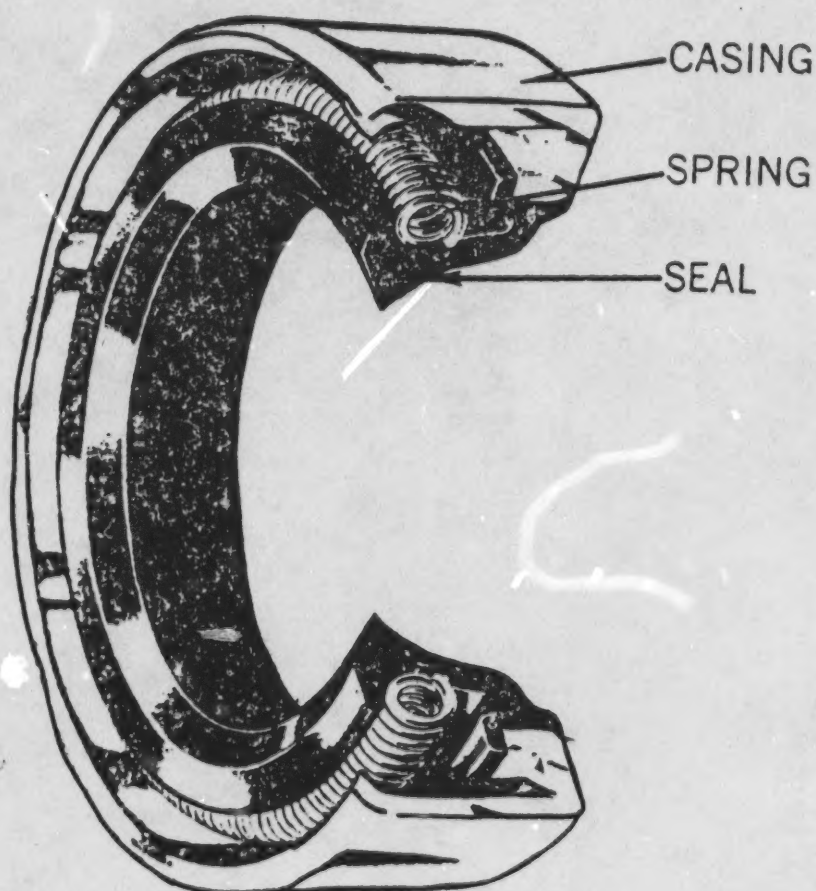
INSTRUCTION SHEET

RVTC

PAGE 22 OF 22

Oil seals are used for the rear of the crankshaft and timing gear cover as shown in Figure 36. They are pressed into a stationary bore in the block or cover and sealed against a moving shaft to prevent oil from escaping. These seals generally consist of a metal casing to which a synthetic rubber sealing element is bonded. As shown in Figure 37, most oil seals utilize a garter spring to provide the proper pressure between the seal and rotating shaft.

Figure 37



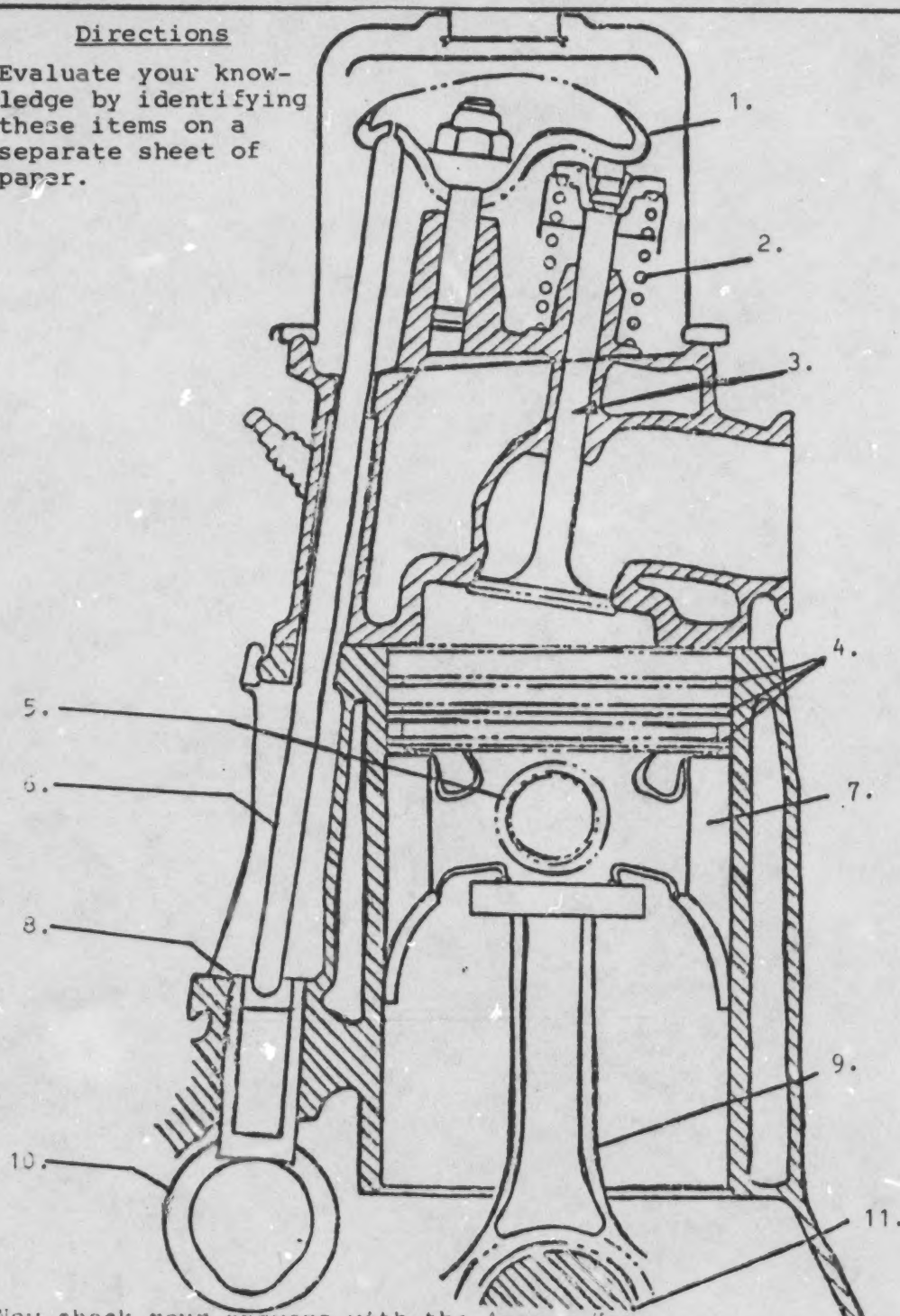
DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	B	07	5

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by identifying these items on a separate sheet of paper.



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	07	5

SELF-CHECK

RVTC

Answer Key

1. rocker arm
2. valve spring
3. valve
4. rings
5. piston pin
6. push rod
7. piston
8. valve lifter
9. connecting rod
10. camshaft
11. crankshaft

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	07	5

WRITTEN TEST FOR TASK NO. B-07

RVTC

TASK: Identify Engine Components

IN-9043-B-07

DirectionsPAGE 1 OF 4

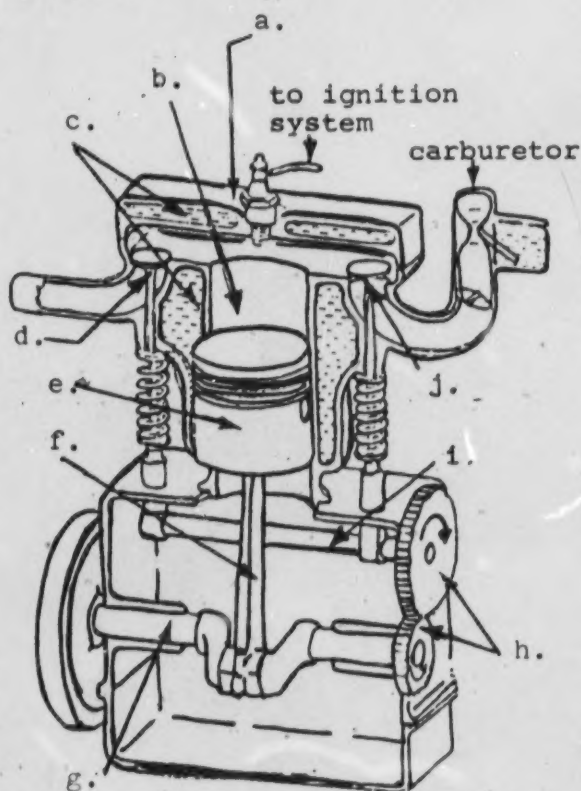
The purpose of this test is to determine if you fully understand how to identify engine components. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or re-testing.

The items below are Matching. On the separate Answer Sheet, write the letter of the item that best identifies each item.

DO NOT MARK ON THIS TEST!

Matching questions

1. combustion chamber
2. valve tappet
3. fuel pump
4. intake valve
5. cylinder head
6. connecting rod
7. piston
8. exhaust valve
9. transmission
10. camshaft
11. water jackets
12. crankshaft
13. timing gears
14. tailpipe
15. flywheel
16. carburetor
17. spark plug
18. battery



DEPT.	PROG.	DUTY	TASK
IN	9043	B	07

WRITTEN TEST FOR TASK NO. B-07

RVTC

TASK:

Identify Engine Components

PAGE 2 OF 4

The items below are Multiple Choice. On the separate Answer Sheet, put the letter of the correct answer in the blank to the left of the number of the question.

Multiple Choice questions

1. What supplies vaporized fuel to the air passing into the engine cylinder?
 - a. piston
 - b. carburetor
 - c. transmission
 - d. fuel pump
2. Lubricating oil permits engine parts to:
 - a. wear out faster.
 - b. gain power.
 - c. move easily and keep wear to a minimum.
 - d. break.
3. The fuel is ignited:
 - a. at the end of the compression stroke.
 - b. when it is in the carburetor.
 - c. during the power stroke.
 - d. by the piston.
4. There are two banks of cylinders above the crankshaft on a/an:
 - a. V or Y type engine.
 - b. in-line engine.
 - c. opposed engine.
 - d. all of the above.
5. Engine overheating is prevented by:
 - a. the transmission.
 - b. the cooling system.
 - c. the exhaust system.
 - d. an air conditioner.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	07

IN-9043-B-07

WRITTEN TEST FOR TASK NO. B-07

RVTC

TASK:

Identify Engine Components

PAGE 3 OF 4

IN-9043-B-07

6. All cylinders are in a straight line above the crankshaft on:
 - a. in-line engines.
 - b. V or Y type engines.
 - c. opposed engines.
 - d. all of the above.
7. There are two rows of cylinders opposite the crankshaft on:
 - a. in-line engines.
 - b. V or Y type engines.
 - c. opposed engines.
 - d. none of the above.
8. Condensate acid moisture is most destructive when:
 - a. the engine has run for several hours.
 - b. both the engine and the exhaust system parts are cold.
 - c. there is a leak in the cylinder block.
 - d. the battery is too old.
9. The federal government has regulations governing:
 - a. exhaust emissions.
 - b. exhaust emissions and oxides of nitrogen emissions.
 - c. design of air filters.
 - d. design of mufflers.
10. An emission control system which is standard on all American made cars built since 1971 and prevents fuel vapors from escaping into the atmosphere is the:
 - a. PCV valve system.
 - b. engine modification system.
 - c. catalytic converter.
 - d. Fuel Evaporation Emission Control System.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	07

WRITTEN TEST FOR TASK NO. B-07

RVTC

TASK:

Identify Engine Components

PAGE 4 OF 4

The items below are True-False. On the separate Answer Sheet, circle T if the item is True and F if the item is False.

DO NOT MARK ON THIS TEST!

True-False questions

1. The most complicated component of the modern day automobile is the carburetor.
2. Gasoline engines use 2 basic types of fuel filters.
3. The main source of silencing exhaust gas noises is in the muffler.
4. Minute particles of dust entering an engine through the air intake system will not hurt the engine.
5. The purpose of the flywheel is to keep the crankshaft spinning between power strokes.
6. A resonator is a smaller silencing element in some exhaust systems.
7. Automobile engines should use an air filter.
8. There are 5 major categories in an engine today. They are cylinder block assembly, valve train assembly, carburetion assembly, lubrication assembly and gaskets and oil seals.
9. The PCV or positive crankcase ventilation system, installed on vehicles since 1962 helps the crankcase emissions reach the outside atmosphere.
10. The principle objective of an engine is to provide a place for the air/fuel mixture to burn and be converted into a form that will move the car.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	07

WRITTEN TEST FOR TASK NO. B-07
RVTC
TASK:

Identify Engine Components

ANSWER KEY
PAGE 1 OF 1
Multiple Choice questions

- | | | | | |
|-------------|--------------|-----------|-----------|-----------|
| <u>b</u> 1. | <u>a</u> 6. | _____ 11. | _____ 16. | _____ 21. |
| <u>c</u> 2. | <u>c</u> 7. | _____ 12. | _____ 17. | _____ 22. |
| <u>a</u> 3. | <u>b</u> 8. | _____ 13. | _____ 18. | _____ 23. |
| <u>a</u> 4. | <u>b</u> 9. | _____ 14. | _____ 19. | _____ 24. |
| <u>b</u> 5. | <u>d</u> 10. | _____ 15. | _____ 20. | _____ 25. |

True-False questions

- | | | | | |
|----------|-----------|---------|---------|---------|
| (T) F 1. | (T) F 6. | T F 11. | T F 16. | T F 21. |
| T (F) 2. | (T) F 7. | T F 12. | T F 17. | T F 22. |
| (T) F 3. | T (F) 8. | T F 13. | T F 18. | T F 23. |
| T (F) 4. | T (F) 9. | T F 14. | T F 19. | T F 24. |
| (T) F 5. | (T) F 10. | T F 15. | T F 20. | T F 25. |

Matching questions

- | | | | | |
|-------------|--------------|--------------|-----------|-----------|
| <u>a</u> 1. | <u>g</u> 6. | <u>d</u> 11. | _____ 16. | _____ 21. |
| <u>e</u> 2. | <u>f</u> 7. | _____ 12. | _____ 17. | _____ 22. |
| <u>k</u> 3. | <u>l</u> 8. | _____ 13. | _____ 18. | _____ 23. |
| <u>h</u> 4. | <u>m</u> 9. | _____ 14. | _____ 19. | _____ 24. |
| _____ 5. | <u>j</u> 10. | _____ 15. | _____ 20. | _____ 25. |

DEPT.	PROG.	DUTY	TASK
IN	9043	B	07

PERFORMANCE TEST FOR TASK NO. B-07

RVTC

IN-9043-B-07

TASK: Identify Engine Components

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will identify engine components. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Was fuel line identified?		
2.	Was fuel filter identified?		
3.	Was fuel pump identified?		
4.	Was carburetor identified?		
5.	Was air cleaner identified?		
6.	Was intake manifold identified?		
7.	Was exhaust manifold identified?		
8.	Was valve (s) identified?		
9.	Was piston identified?		
10.	Was rings identified?		
11.	Was connecting rod identified?		
12.	Was piston pin identified?		
13.	Was crankshaft identified?		
14.	Was camshaft identified?		
☐ ATTAINED ☐ NOT ATTAINED		EVALUATOR'S SIGNATURE _____	
Score _____			
DEPT.	PROG.	DUTY	TASK
IN	9043	B	07
Page 1 of 2			

PERFORMANCE TEST FOR TASK NO. B-07
CONT.

IN-9043-B-07

ITEM NO.	ITEMS TO BE EVALUATED (CONT.):	YES	NO
15.	Was lifter(s) identified?		
16.	Was push rod(s) identified?		
17.	Was rocker arm(s) identified?		
18.	Was valve spring(S) identified?		
19.	Was timing gears (or chains) identified?		
20.	Was "Y" (crossover) or "H" pipe identified?		
21.	Was intermediate pipe identified?		
22.	Was muffler identified?		
23.	Was tailpipe identified?		
24.	Was catalytic converter identified?		
25.	Was exhaust system hangers identified?		
26.	Was exhaust system clamps identified?		

PAGE 2 OF 2

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VO-TECH CENTER

7700 State Road 544 N
Winter Haven, Florida 33880

IN-9043-B-08

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Test Cooling System

DUTY:

Performing Maintenance and Repair on Drive Train

PURPOSE :

Testing and servicing a cooling system is a vital part of the auto mechanic's job. This system is critical to the operation of the engine. This Learning Guide will help you to understand the steps necessary to test and service the cooling system of the automobile.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	B	08	Duty A

REVISED

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:****GIVEN:** special tools and a test vehicle,**YOU WILL:** test the cooling system of the vehicle.**HOW WELL:** You must successfully complete the Written Test.
Your performance will be assessed by your instructor using the Performance Test on page 31.**ENABLING OBJECTIVES:**

1. Identify the components of the cooling system.
2. Check the coolant level and freezing point.
3. Pressure test the cooling system.
4. Inspect the radiator hoses.
5. Test the thermostat.
6. Flush the cooling system.
7. Test the vehicle cooling system.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	08

ENABLING OBJECTIVE NO. 1

3
RVTC

Identify the components of the cooling system.

LEARNING STEPS

1. View Resource No. 1 to identify the cooling system components.
2. Evaluate your knowledge by completing the Self-Check.
3. Go on to Enabling Objective No. 2.

RESOURCES

1. a. Hoffman slide/tape unit:
4.2.9(5)
b. Bergwall Filmstrip/tape:
No. 406.
2. Self-Check enclosed.

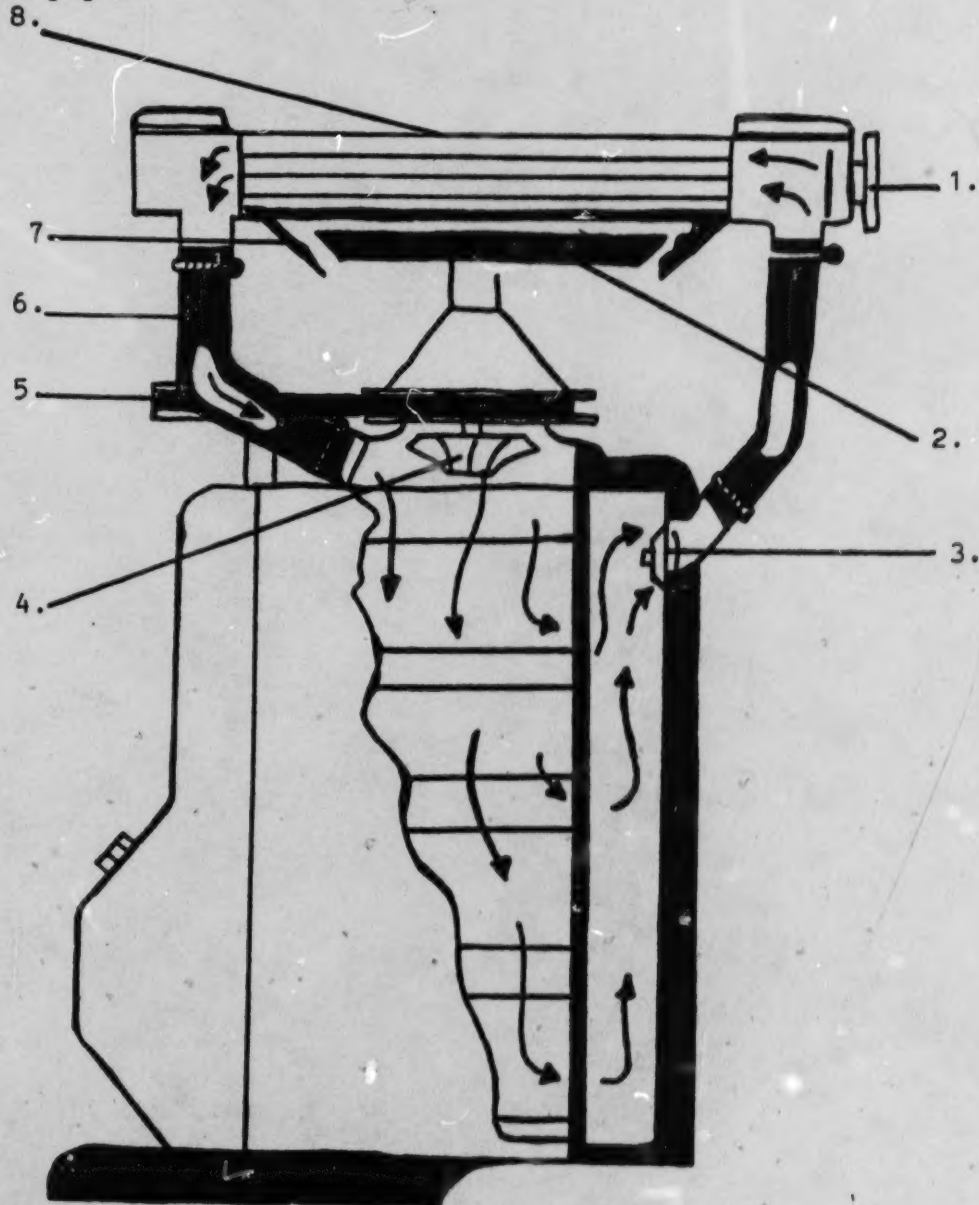
DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	08	1

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by identifying the items below on a separate sheet of paper.



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	08	1

SELF-CHECK

RVTC

Answer Key

1. radiator cap
2. fan
3. thermostat
4. water pump
5. fan belt
6. lower in-let water hose
7. fan shroud
8. radiator

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	08	1

ENABLING OBJECTIVE NO. 2

RVTC

Check the coolant level and freeze point.

LEARNING STEPS

1. Read Resource No. 1 to identify the steps in checking the coolant level.
2. Read Resource No. 2 to identify the steps in testing cooling and freezing point.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 3.

RESOURCES

1. Text: Introduction to Automotive Mechanics, Unit 2, pages 71-74.
2. Text: Introduction to Automotive Mechanics, Unit 2, pages 74-78.
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	08	2

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. In older vehicles without coolant recovery systems, the coolant level should be below the bottom of the filler neck of the radiator by:
 - a. 1/2 to 1 inch.
 - b. 1 1/2 to 3 inches.
 - c. 4 to 6 inches.
 - d. 8 to 10 inches.
2. What effect does ethylene glycol (antifreeze) have on water?
 - a. it does not affect the boiling point of water
 - b. it lowers the boiling point of water
 - c. it raises the boiling point of water
 - d. it does not affect the freezing temperature of water
3. When adding coolant to the cooling system, you should add a mixture of antifreeze and water in what ratio?
 - a. 90/10
 - b. 60/40
 - c. 50/50
 - d. 10/90
4. On newer vehicles with coolant recovery systems, the coolant level should be checked by looking at the:
 - a. coolant level in the radiator.
 - b. see-through coolant recovery tank.
 - c. temperature gauge.
 - d. dipstick.
5. In a cold engine on a vehicle with a coolant recovery system, the coolant level should be near which mark on the coolant recovery stick?
 - a. down two quarts
 - b. down one quart
 - c. full
 - d. add

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	08	2

SELF-CHECK

RVTC

6. At normal engine operating temperatures, the coolant level should be at which mark on the coolant recovery tank?
 - a. down one quart
 - b. down two quarts
 - c. full
 - d. add
7. Which of the following are used to check the coolant freezing point?
 - a. thermometer
 - b. barometer
 - c. hydrometer
 - d. speedometer
8. Two readings can be obtained on a hydrometer. One is the float reading and the other is the:
 - a. specific gravity.
 - b. temperature.
 - c. density.
 - d. conductivity.
9. If a hydrometer float reading of Q is obtained with a temperature reading of 100°F., what will the freezing point of the coolant be?
 - a. + 14°F.
 - b. - 80°F.
 - c. + 32°F.
 - d. - 32°F.
10. When you read a refractometer, you point the refractometer at the:
 - a. light.
 - b. radiator cap.
 - c. recovery tank.
 - d. radiator coolant.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	08	2

SELF-CHECK

RVTC

Answer Key

1. b
2. c
3. c
4. b
5. d
6. c
7. c
8. b
9. a
10. a

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	08	2

ENABLING OBJECTIVE NO. 3

RVTC

Pressure test the cooling system.

LEARNING STEPS

1. Read Resource No. 1 to identify the steps in pressure testing the cooling system.
2. View Resource No. 2 to identify the steps in testing the cooling system.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 4.

RESOURCES

1. Text: Introduction to Automotive Mechanics, Unit 2, pages 82-84.
2. Bergwall Filmstrip/tape: No. 423.
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	08	3

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. The pressure that you apply to the coolant system with a pressure tester should be:
 - a. the same as the radiator cap rated pressure.
 - b. higher than the radiator cap rated pressure.
 - c. lower than the radiator cap rated pressure.
 - d. maximum pressure of tester.
2. There are leaks in the cooling system if the pressure on the pressure tester gauge:
 - a. rises.
 - b. remains the same.
 - c. drops.
 - d. fluctuates.
3. To test a radiator cap, you:
 - a. push on the bottom spring.
 - b. attach it to a pressure tester.
 - c. heat it in a pan of water.
 - d. put it in a vise.
4. In a closed cooling system, the vacuum relief valve in the radiator cap:
 - a. allows coolant to be drawn into the radiator as the system cools.
 - b. allows air to be drawn into the radiator as the system cools.
 - c. allows coolant to be drawn into the radiator as system overheats.
 - d. allows coolant to enter the reservoir as system cools.
5. When replacing a radiator cap, choose one with a pressure rating that is:
 - a. the same as the old one.
 - b. higher than the old one.
 - c. lower than the old one.
 - d. recommended by the manufacturer.
6. A radiator cap is defective if it:
 - a. holds pressure above its rated capacity.
 - b. releases pressure below its rated capacity.
 - c. leaks coolant.
 - d. all of the above.

DEPT.	PROG.	DUTY	TASK	EN. NO.
IN	9043	B	08	3

SELF-CHECK**RVTC**Answer Key

1. a
2. c
3. b
4. a
5. a
6. b

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	08	3

ENABLING OBJECTIVE NO. 4

RVTC

Inspect the radiator hoses.

LEARNING STEPS

1. Read Resource No. 1 to identify the steps in inspecting the radiator hoses.
2. Evaluate your knowledge by completing the Self-Check.
3. Go on to Enabling Objective No. 5.

RESOURCES

1. Text: Introduction to Automotive Mechanics, Unit 2, pages 87-91.
2. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	08	4

SELF-CHECK

RVTC

Directions

Evaluate your work by putting the letter of the correct answer on a separate sheet of paper.

1. The upper radiator hose is connected to the:
 - a. lower radiator tank.
 - b. water pump.
 - c. thermostat housing.
 - d. fuel pump.
2. The lower radiator hose is connected to the:
 - a. upper radiator tank.
 - b. water pump.
 - c. thermostat housing.
 - d. fuel pump.
3. If the radiator hoses feel soft and spongy:
 - a. they should be replaced.
 - b. they are in good condition.
 - c. this indicates poor radiator pressure.
 - d. this indicates a defective water pump.
4. If the radiator hoses are very hard, they:
 - a. are in good condition.
 - b. will not seal properly.
 - c. are in poor condition.
 - d. should be replaced.
5. The first step in replacing damaged radiator hoses is to:
 - a. unscrew the hose clamps.
 - b. drain the radiator by opening the draincock.
 - c. cut the hoses with a knife.
 - d. remove the radiator cap.
6. If snap-type hose clamps are found on old radiator hoses, these should be:
 - a. reused.
 - b. replaced with screw-type clamps.
 - c. replaced with aircraft type clamps.
 - d. re-shaped for tightness before re-using.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	E	08	4

SELF-CHECK**RVTC**

7. In order to select the proper radiator hoses, you should know the following information:
 - a. vehicle make and model.
 - b. vehicle body style.
 - c. vehicle make, model and engine size (displacement).
 - d. vehicle radiator type.
8. The radiator hose clamp should be positioned at what distance from the end of the hose?
 - a. 3/4 inch
 - b. 1 inch
 - c. 1 1/2 inch
 - d. 1/8 inch
9. When you have finished installing new radiator hoses, you should check for leaks by:
 - a. running the engine until the normal operating temperature is reached, and then looking at the hose ends.
 - b. looking at the hose ends while the engine is cold.
 - c. attaching the pressure tester and checking for leaks.
 - d. having the customer return after 30 minutes of driving.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	08	4

SELF-CHECK

RVTC

Answer Key

1. c
2. b
3. a
4. d
5. b
6. b
7. c
8. d
9. a

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	08	4

ENABLING OBJECTIVE NO. 5

RVTC

Test the thermostat.

LEARNING STEPS

1. Read Resource No. 1 to identify the steps in removing the thermostat.
2. Read Resource No. 2 to identify the steps in testing the thermostat.
3. Read Resource No. 3 to identify the steps in installing the thermostat.
4. Evaluate your knowledge by completing the Self-Check.
5. Go on to Enabling Objective No. 6.

RESOURCES

1. Text: Introduction to Automotive Mechanics, Unit 2, page 94.
2. Text: Introduction to Automotive Mechanics, Unit 2, pages 94-95.
3. Text: Introduction to Automotive Mechanics, Unit 2, pages 95-96.
4. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	08	5

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. Before you remove the thermostat, you must:
 - a. drain part of the coolant.
 - b. remove the radiator hose from the thermostat housing.
 - c. remove the top of the thermostat housing.
 - d. all of the above.
2. Generally, the thermostat gasket:
 - a. can be saved.
 - b. must be replaced.
 - c. can be used again if the sealer is applied.
 - d. is not included as part of the thermostat replacement part.
3. The correct thermostat is selected by:
 - a. looking at the old thermostat.
 - b. looking in parts catalog.
 - c. asking someone with the same type vehicle.
 - d. the size of the opening of the housing.
4. To keep dirt from falling in the throat of the thermostat housing when you scrape off the old thermostat gasket, you should:
 - a. scrape away from the throat.
 - b. put a rag in the throat.
 - c. blow the throat clean with an air hose after cleaning.
 - d. scrape the old gasket before removing the thermostat.
5. The thermostat must be positioned so that the pellet (or bellows) is toward the:
 - a. radiator.
 - b. engine block.
 - c. water pump.
 - d. front.
6. After installing a thermostat, you should check the:
 - a. clamps.
 - b. hose.
 - c. thermostat housing for leaks.
 - d. all of the above.
7. Be sure that the thermostat flange seats squarely in the:
 - a. hose clamps.
 - b. radiator hose.
 - c. flange pocket or recess.
 - d. gasket.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	08	5

SELF-CHECK

RVTC

Answer Key

1. d
2. b
3. b
4. b
5. b
6. d
7. c

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	08	5

ENABLING OBJECTIVE NO. 6

RVTC

Flush the cooling system.

LEARNING STEPS

1. Read Resource No. 1 to identify the steps in reverse flushing the cooling system.
2. Read Resource No. 2 to identify the process of reverse flushing with air pressure.
3. Evaluate your knowledge by completing the Self-Check.
4. When you think you can attain this task, take the Written Test.
5. Go on to Enabling Objective No. 7.

RESOURCES

1. Text: Introduction to Automotive Mechanics, Unit 2, pages 99 - 100.
2. Text: Introduction to Automotive Mechanics, Unit 2, pages 101 - 103.
3. Self-Check enclosed.
4. Written Test for task B-08.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	B	08	6

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. When you are preparing to reverse flush and fill the cooling system, you should set the heater control valve on:
 - a. low.
 - b. high.
 - c. medium.
 - d. off.
2. When reverse flushing and filling the cooling system, the water supply should be connected directly to the:
 - a. radiator cap.
 - b. heater supply nipple at the engine block or water pump.
 - c. upper radiator hose.
 - d. lower radiator hose.
3. When flushing, you should use:
 - a. hot water.
 - b. cool water.
 - c. air only.
 - d. engine coolant.
4. The purpose of reverse flushing the radiator with air pressure and water is to:
 - a. protect the radiator from corrosion.
 - b. clean out old antifreeze.
 - c. loosen deposits of heavy material from the cooling system.
 - d. test for leaks.
5. Which of the following pieces of equipment is used to reverse flush the radiator?
 - a. garden hose
 - b. reverse flushing gun
 - c. air hose
 - d. clear plastic tubing

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	08	6

SELF-CHECK

RVTC

6. Before reverse flushing, you should remove the:
 - a. lower hose.
 - b. thermostat.
 - c. heater.
 - d. draincock.
7. When you are reverse flushing the radiator, you should apply air pressure:
 - a. continuously.
 - b. in short bursts.
 - c. in long bursts.
 - d. to the lower hose outlet.
8. When reverse flushing, you should turn off the water when:
 - a. three minutes have passed.
 - b. the drain water runs clean.
 - c. 10 minutes have passed.
 - d. the engine has cooled off.
9. When reverse flushing the engine block, you should connect the reverse flushing gun to the:
 - a. radiator end of the upper radiator hose.
 - b. radiator cap.
 - c. free end of the lower radiator hose.
 - d. free end of the heater hose.
10. To check for leaks after reverse flushing the engine block, you should:
 - a. visually inspect for leaks.
 - b. pressure test for leaks.
 - c. both of the above.
 - d. none of the above.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	08	6

SELF-CHECK

RVTC

Answer Key

1. b
2. b
3. b
4. c
5. b
6. b
7. b
8. b
9. a
10. c

All of your answers should agree with the answers on the Answer Key.
 If you missed any, go back and repeat one or more of the Learning
 Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	B	08	6

ENABLING OBJECTIVE NO. 7

RVTC

Test the vehicle cooling system..

LEARNING STEPS

1. View Resource No. 1 to review the steps in testing the cooling system.
2. Practice testing the cooling system of a vehicle using Resource No. 2.
3. When you think you can perform this task, take the Performance Test.

RESOURCES

1. Bergwall Filmstrip/tape: No. 423.
2. a. Shop engine -- 350 CDI
b. Inspection Sheet enclosed.
3. Performance Test for task B-08.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	7	08	7

INSPECTION SHEET

RVTC

Directions

Visually inspect or test the following cooling system components and record their condition and/or test results.

1. Leaks or signs of leakage at:

A. radiator hose connections	OK _____	LEAKING _____
B. heater hose connections	_____	_____
C. bypass hose connections (if so equipped)	_____	_____
D. radiator seams	_____	_____
E. radiator petcock	_____	_____
F. passage at front of intake manifold	_____	_____
G. water outlet housing	_____	_____
H. water pump front seal	_____	_____
I. water pump gasket	_____	_____
J. fittings and drain plugs	_____	_____
K. block core plugs	_____	_____
L. heater core	_____	_____
M. heater control valve (if so equipped)	_____	_____

2. Check coolant level OK _____ LOW _____

CAUTION: THE SYSTEM MAY BE UNDER PRESSURE AND THE COOLANT MAY BE HOT! EXERCISE EXTREME CARE IN REMOVING THE PRESSURE CAP. LOOSEN TO FIRST STOP ONLY AND RELEASE ANY PRESSURE THAT MAY BE PRESENT. THEN THE CAP MAY BE REMOVED COMPLETELY.

3. Water pump front bearing OK _____ LOOSE _____

4. Drive belt tension OK _____ LOOSE _____

5. Drive belt condition

OK	_____
CRACKED	_____
WORN	_____
GLAZED	_____
FRAYED	_____

6. Hose condition

OK	_____
*HARD	_____
*CRACKED	_____
*SOFT	_____

* If anything other than OK, explain.

WRITTEN TEST FOR TASK NO. B-08

RVTC

TASK:

Test Cooling System

IN-9043-B-08

DirectionsPAGE 1 OF 3

The purpose of this test is to determine if you fully understand how to test the cooling system. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Multiple Choice. On the separate Answer Sheet, put the letter of the correct answer in the blank to the left of the number of the question.

DO NOT MARK ON THIS TEST!

Multiple Choice questions

1. If the coolant level in the radiator is low, you should add:
 - a. tap water.
 - b. equal parts of antifreeze and water.
 - c. two parts antifreeze to one part water.
 - d. two parts water to one part antifreeze.
2. A hydrometer shows the:
 - a. color of the coolant.
 - b. density of the coolant.
 - c. freezing point of the coolant.
 - d. pressure in the radiator.
3. Which of the following are readings taken from a hydrometer?
 - a. temperature and pressure
 - b. temperature and coolant level
 - c. pressure and float level
 - d. density and temperature
4. The coolant level on newer vehicles with coolant recovery systems should be checked by looking at the:
 - a. coolant level in the radiator.
 - b. temperature gauge.
 - c. dipstick.
 - d. see-through recovery coolant tank.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	08

WRITTEN TEST FOR TASK NO. B-08

RVTC

TASK:

Test Cooling System

IN-9043-B-08

PAGE 2 OF 3

5. The coolant level on older vehicles without coolant recovery systems should be checked by:
 - a. checking the see-through coolant recovery tank.
 - b. removing the radiator cap and looking at the coolant level.
 - c. checking the temperature gauge.
 - d. checking the dipstick.
6. The reason for pressure-testing a cooling system is to:
 - a. check the freezing point of the coolant.
 - b. check the thermostat.
 - c. check for leaks.
 - d. all of the above.
7. To test a radiator cap:
 - a. put it in a vise.
 - b. attach it to a pressure tester.
 - c. heat it in a pan of water.
 - d. push up on the spring with your finger.
8. The upper radiator hose is connected to the radiator on one end. The other end is connected to the:
 - a. lower radiator tank.
 - b. water pump.
 - c. thermostat housing.
 - d. fuel pump.
9. The lower radiator hose is connected to the radiator on one end. The other end is connected to the:
 - a. upper radiator tank.
 - b. water pump.
 - c. thermostat housing.
 - d. fuel pump.
10. Radiator hoses should be replaced if they are:
 - a. soft and spongy.
 - b. very hard.
 - c. leaking.
 - d. both a and b.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	08

WRITTEN TEST FOR TASK NO. B-08

RVTC

TASK:

Test Cooling System

PAGE 3 OF 3

11. If snap-type hose clamps are used on the old radiator hoses, these should be:
 - a. reused.
 - b. replaced with screw-type clamps.
 - c. replaced with aircraft clamps.
 - d. replaced with wire clamps.
12. Before you remove the thermostat, you must:
 - a. drain some of the coolant out of the system.
 - b. remove the radiator hose from the thermostat housing.
 - c. remove the top of the thermostat housing.
 - d. all of the above.
13. When you are reverse flushing and filling the cooling system, the water supply should be connected directly to the:
 - a. radiator cap.
 - b. heater supply nipple at the engine block or water pump.
 - c. upper radiator hose.
 - d. lower radiator hose.
14. What piece of equipment is used to reverse flush the radiator?
 - a. garden hose.
 - b. reverse flushing gun.
 - c. air hose.
 - d. clear plastic tubing.
15. Before reverse flushing the radiator system, you should disconnect the:
 - a. lower hose.
 - b. upper radiator hose.
 - c. both a and b above.
 - d. heater hose.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	08

WRITTEN TEST FOR TASK NO. B-08

RVTC

TASK:

Test Cooling System

ANSWER KEY

PAGE 1 OF 1

Multiple Choice questions

<u>b</u> 1.	<u>c</u> 6.	<u>b</u> 11.	<u> </u> 16.	<u> </u> 21.
<u>c</u> 2.	<u>b</u> 7.	<u>d</u> 12.	<u> </u> 17.	<u> </u> 22.
<u>d</u> 3.	<u>c</u> 8.	<u>b</u> 13.	<u> </u> 18.	<u> </u> 23.
<u>d</u> 4.	<u>b</u> 9.	<u>b</u> 14.	<u> </u> 19.	<u> </u> 24.
<u>b</u> 5.	<u>d</u> 10.	<u>c</u> 15.	<u> </u> 20.	<u> </u> 25.

True-False questions

T F 1.	T F 6.	T F 11.	T F 16.	T F 21.
T F 2.	T F 7.	T F 12.	T F 17.	T F 22.
T F 3.	T F 8.	T F 13.	T F 18.	T F 23.
T F 4.	T F 9.	T F 14.	T F 19.	T F 24.
T F 5.	T F 10.	T F 15.	T F 20.	T F 25.

Matching questions

<u> </u> 1.	<u> </u> 6.	<u> </u> 11.	<u> </u> 16.	<u> </u> 21.
<u> </u> 2.	<u> </u> 7.	<u> </u> 12.	<u> </u> 17.	<u> </u> 22.
<u> </u> 3.	<u> </u> 8.	<u> </u> 13.	<u> </u> 18.	<u> </u> 23.
<u> </u> 4.	<u> </u> 9.	<u> </u> 14.	<u> </u> 19.	<u> </u> 24.
<u> </u> 5.	<u> </u> 10.	<u> </u> 15.	<u> </u> 20.	<u> </u> 25.

DEPT.	PROG.	DUTY	TASK
IN	9043	B	08

PERFORMANCE TEST FOR TASK NO. B-08

RVTC

IN-9043-B-08

TASK:

Test Cooling System

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will test the cooling system. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Was the coolant level checked?.....		
2.	Was the freezing point checked?.....		
3.	Was the pressure test completed?.....		
4.	Was the thermostat tested?.....		
5.	Was the system checked to see if it needed flushing?.....		
6.	Were specifications from the vehicle's Maintenance Manual used?.....		
7.	Were the radiator hoses checked for damage or wear?.....		
8.	Were the heater hoses checked for leaks, damage or wear?.....		
9.	Was the water pump checked for leaks or damage?.....		
10.	Was the Inspection Sheet completed as the check was made?.....		

☐ ATTAINED
☐ NOT ATTAINED

Score _____

DEPT.	PROG.	DUTY	TASK	ATTEMPT
IN	9043	B	08	

EVALUATOR'S SIGNATURE _____
 Page 1 of 1

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RIDGE

VO-TECH CENTER

7700 State Road 544 N
Winter Haven, Florida 33880

IN-9043-C-01

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Identify and Describe Basic Electrical Components

DUTY:

Troubleshooting and Repairing Electrical System

PURPOSE :

Electrical components are an important part of automobiles today. More and more electrical devices are replacing mechanical devices with each model change. Today's mechanic must be an electrician on D.C. power as well as a technician on mechanical parts of the automobile. Without the basic electrical components working together, a vehicle cannot operate. This Learning Guide will help you to understand basic electrical components.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	C	01	

REVISED :

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STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:****GIVEN:** tools and a test vehicle,**YOU WILL:** identify and describe basic electrical components.**HOW WELL:** Your performance will be assessed by your instructor using the Performance Test on page 12.**ENABLING OBJECTIVES:**

1. Identify the storage battery and its components.
2. Identify the starting circuit and its components.
3. Identify the charging system and its components.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	01

ENABLING OBJECTIVE NO. 1
RVTC

Identify the storage battery and its components.

LEARNING STEPS

1. View Resource No. 1a or read Resource No. 1b to identify the battery and its components.
2. Evaluate your knowledge by completing the Self-Check.
3. Go on to Enabling Objective No. 2.

RESOURCES

1. a. Hoffman slide/tape units: 4.1 and 4.1.1.
b. Text: Crouse Automotive Mechanics, pages 248 - 252.
2. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	01	1

SELF-CHECK**RVTC**Directions

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. Any 12 volt battery will operate a 12 volt automobile electrical system.
2. Batteries produce current through chemical means.
3. Batteries are rated by reserve capacity.
4. All batteries are connected with the negative post to ground.
5. 100 degrees is the peak operating temperature of an automobile battery.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	01	1

SELF-CHECK

5

RVTC

Answer Key

1. F
2. T
3. T
4. F
5. F

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	01	1

ENABLING OBJECTIVE NO. 2
RVTC

Identify the starting circuit and its components.

LEARNING STEPS

1. View Resource No. 1a or read Resource No. 1b to identify the starting circuits.
2. View Resource No. 2a or read Resource No. 2b to identify the starting system components.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 3.

RESOURCES

1.
 - a. Hoffman slide/tape unit: 4.6.
 - b. Text: Crouse Automotive Mechanics, pages 265-272
2.
 - a. Hoffman slide/tape unit: 4.6.1.
 - b. Text: Crouse Automotive Mechanics, pages 270-271.
3. Self-Check enclosed.

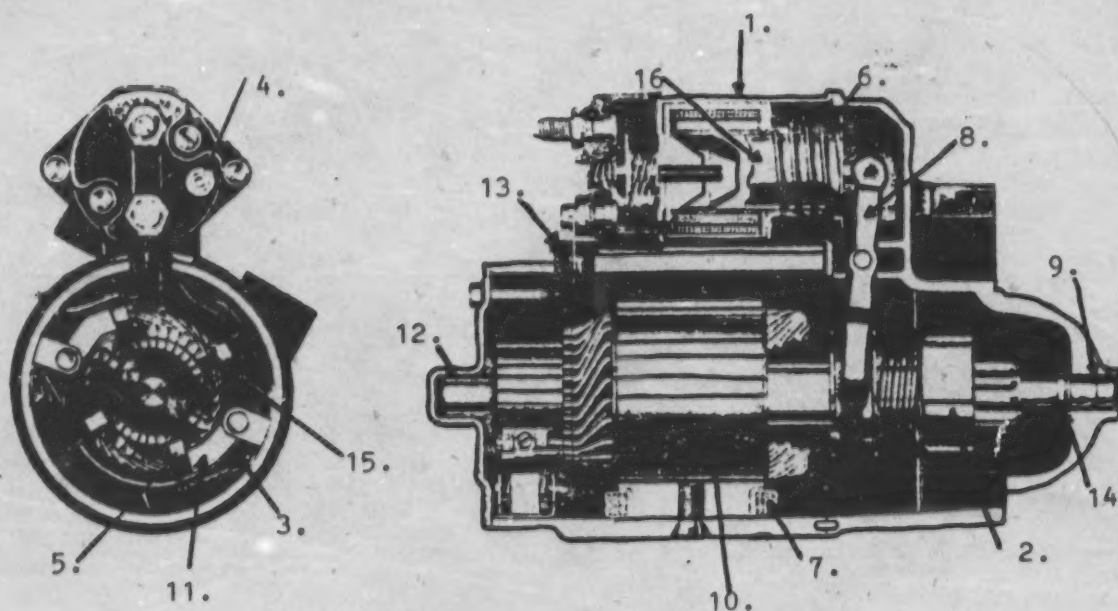
DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	01	2

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by identifying the items below on a separate sheet of paper.



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	01	2

SELF-CHECK

RVTC

Answer Key

1. solenoid
2. over running clutch
3. brush spring
4. switch terminal
5. brush
6. return spring
7. field coil
8. shift lever
9. bushing
10. armature
11. ground brush holder
12. bushing
13. grommet
14. pinion stop
15. insulated brush holder
16. plunger

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	01	2

ENABLING OBJECTIVE NO. 3

RVTC

Identify the charging system and its components.

LEARNING STEPS

1. View Resource No. 1a or read Resource No. 1b to identify the charging system and its components.
2. Evaluate your knowledge by completing the Self-Check.
3. When you think you can perform this task, take the Performance Test.

RESOURCES

1. a. Hoffman slide/tape units: 5.1.1 and 5.2.1.
b. Text: Crouse Automotive Mechanics, pages 280-289.
2. Self-Check enclosed.
3. Performance Test for task C-01.

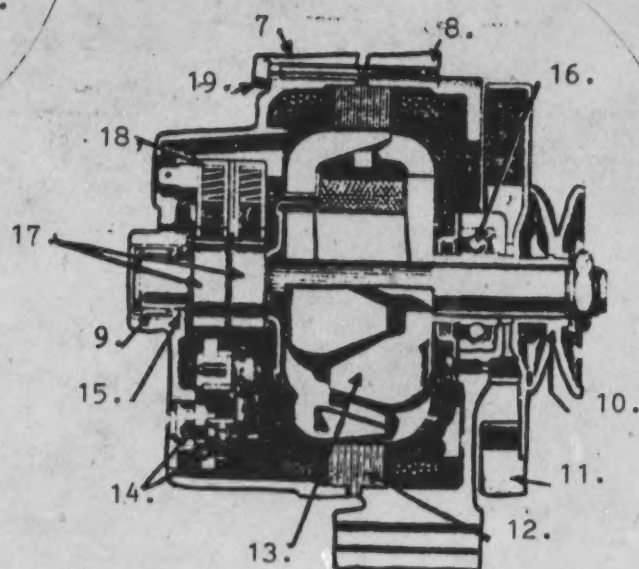
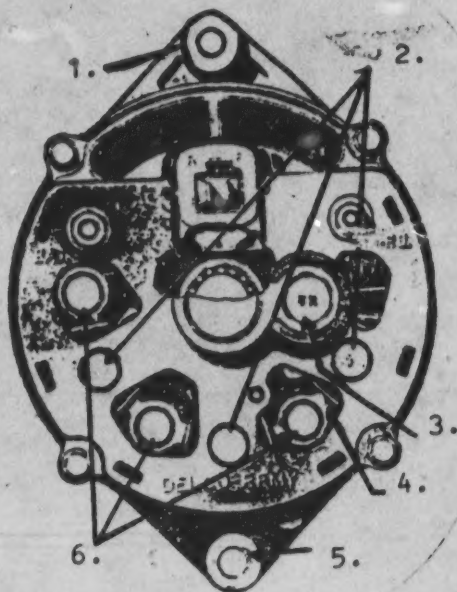
DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	01	3

SELF-CHECK

RVTC

Directions

Evaluate your progress by identifying the items below on a separate sheet of paper.



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	01	3

SELF-CHECK

RVTC

Answer Key

1. adjusting lug
2. end frame diodes
3. capacitor
4. heat sink
5. mounting lug
6. heat sink diodes
7. end frame - slip ring
8. end frame - drive
9. bearing
10. pulley
11. fan
12. stator assembly
13. rotor
14. diodes
15. seal
16. bearing
17. slip ring
18. brush assembly
19. thru bolt

All of your answers should agree with the answers in the Answer Key.
 If you missed any, go back and repeat one or more of the Learning
 Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	01	3

PERFORMANCE TEST FOR TASK NO. C-01

RVTC

TASK:

Identify and Describe Basic Electrical Components

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will identify and describe basic electrical components. You will be evaluated for attainment of this task, based upon the items listed below..

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Was the battery identified?		
2.	Was the battery circuit identified from battery to starter relay?		
3.	Was each terminal on starter relay identified?		
4.	Was each terminal on the alternator identified?		
5.	Was the voltage regulator identified?		
6.	Was the starter motor identified?		
7.	Was the charging system circuit identified?		
8.	Was the starting system circuit identified?		
9.	Were the terminals of the voltage regulator identified?		

☐ ATTAINED
☐ NOT ATTAINED

Score _____

DEPT.	PROG.	DUTY	TASK	ATTEMPT
IN	9043	C	01	

EVALUATOR'S SIGNATURE _____
 Page 1 of 1

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RIDGE

VO-TECH CENTER

7700 State Road 544 N
Winter Haven, Florida 33880

IN-9043-C-02

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Identify, Service and Test a Battery

DUTY:

Troubleshooting and Repairing Electrical System

PURPOSE :

The battery of an automobile has a life expectancy of up to five years if proper servicing and maintenance is performed. It is essential for a mechanic to know the servicing procedures for a battery in order to provide good service to the customers.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	C	02	C-01

REVISED

STUDENT PERFORMANCE OBJECTIVES:

²
RVTC

TERMINAL PERFORMANCE OBJECTIVE:

GIVEN: work station, battery and tools,

YOU WILL: service and test a battery.

HOW WELL: Your performance will be assessed by your instructor using the Performance Test on page 12.

ENABLING OBJECTIVES:

1. Identify battery components and their purpose.
2. Service and test the condition of the battery.
3. Replace the battery.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	02

ENABLING OBJECTIVE NO. 1

RVTC

Identify battery components and their purpose.

LEARNING STEPS

1. Read Resource No. 1 to identify the battery components and their purpose.
2. Evaluate your knowledge by completing the Self-Check.
3. Go on to Enabling Objective No. 2.

RESOURCES

1. Text: Crouse Automotive Mechanics, pages 248 - 251.
2. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	02	1

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. The only purpose of the battery is to start the engine, since other electrical parts, such as lights, radio, etc. use energy from the alternator.
2. The three chemicals inside a battery are: sponge lead, lead oxide, and water.
3. Each cell in the battery supplies two volts.
4. Reserve capacity is the length of time in minutes a battery can deliver 25 amps. at 80 F.
5. Two 12 volt batteries hooked in series will produce 12 volts.
6. Batteries are hooked in a series to boost-start an engine.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	02	1

SELF-CHECK

RVTC

Answer Key

1. F
2. F
3. T
4. T
5. F
6. F

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	02	1

ENABLING OBJECTIVE NO. 2
RVTC

Service and test the condition of a battery.

LEARNING STEPS

1. View and complete Resource No. 1 to identify the procedure for charging a battery.
2. View and complete Resource No. 2 to identify the procedure for using the hydrometer.
3. View and complete Resource No. 3 to identify the procedure for computing a three minute battery check.
4. View and complete Resource No. 4 to identify the procedure for testing high rate discharge.
5. Evaluate your knowledge by completing the Self-Check.
6. Go on to Enabling Objective No. 3.

RESOURCES

1. a. Hoffman slide/tape unit: 4.2.A.
b. Battery
2. Hoffman slide/tape unit: 4.2.B.
3. Hoffman slide/tape unit: 4.2.C.
4. Hoffman slide/tape unit: 4.2.D.
5. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	02	2

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. The fast charge rate for a 12 volt battery is 70 amps.
2. The fast charge rate for a six volt battery is 40 amps.
3. The maximum charge in a battery is determined by the specific gravity.
4. The specific gravity is a measurement of the acid in the battery.
5. If the specific gravity reading is 1.230, this indicates the battery should be replaced.
6. The three-minute check determines if a battery is usable, non-usable or chargeable.
7. The test load for a 60 ampere hour battery is 180 amperes on the 15 second load test.
8. After the three-minute charge the voltage on a 12 volt battery is 13.1 volts, this indicates that the battery is non-usable.
9. Specific gravity must be below 1.220 to complete the high rate discharge test.
10. Voltage in the 12 volt battery tested was 1.1 volts in cell No. 1 and 2.1 volts in cell No. 2, this indicates that the battery is bad.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	02	2

SELF-CHECK

RVTC

Answer Key

1. F
2. F
3. T
4. T
5. F
6. T
7. T
8. F
9. F
10. T

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	02	2

ENABLING OBJECTIVE NO. 3
RVTC

Replace the battery.

LEARNING STEPS

1. View and complete Resource No. 1 to identify the steps in preparing to replace a battery.
2. View and complete Resource No. 2 to identify the procedure for removing and installing a battery.
3. Evaluate your knowledge by completing the Self-Check.
4. When you think you can perform this task, take the Performance Test.

RESOURCES

1. Hoffman slide/tape unit: 4.3.A.
2. Hoffman slide/tape units: 4.4.1 and 4.4.B.
3. Self-Check enclosed.
4. Performance Test for task C-02.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	02	3

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. New batteries are ready to install in the automobile without any preparation by the mechanic.
2. Acid should be filled to the split level of the battery hole (above the plates).
3. If acid should come in contact with your skin, flush it with cold water at once.
4. When replacing the battery you should remove the negative terminal first.
5. Should the battery cups be removed while the battery is charging. ?

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	02	3

SELF-CHECK

RVTC

Answer Key

- 1. F
- 2. T
- 3. T
- 4. T
- 5. F

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	02	3

PERFORMANCE TEST FOR TASK NO. C-02

RVTC

TASK:

Identify, Service and Test a Battery

IN-9043-C-02

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: In a shop situation, you will service and test a battery. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
		1.	Was the battery cleaned?
2.	Was the battery checked for leakage?		
3.	Was the specific gravity test completed?		
4.	Was the high discharge test completed?		
5.	Was the three minute charging test completed?		
6.	Were the values recorded accurately as per specifications of the battery manufacturer?		
7.	Was the negative terminal removed first?		
8.	Were the terminals cleaned?		
9.	Were all tools and equipment returned to the proper storage area?		

☐ ATTAINED
☐ NOT ATTAINED

Score _____ EVALUATOR'S SIGNATURE _____

DEPT.	PROG.	DUTY	TASK	ATTEMPT
IN	9043	C	02	

Page 1 of 1

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VO-TECH CENTER

7700 State Road 544 N
Winter Haven, Florida 33880

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Connect Scope and Interpret Patterns

DUTY:

Troubleshooting and Repairing Electric System

PURPOSE :

The scope is a valuable tool to the mechanic who is knowledgeable in its operation. The scope patterns reflect the condition of the ignition system. However, the usefulness of this machine is limited to the mechanic's ability to interpret the patterns.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	C	11	C-10

REVISED :

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

GIVEN: an oscilloscope and test ignition system,

YOU WILL: connect scope and interpret patterns.

HOW WELL: You must successfully complete the Written Test.
Your performance will be assessed by your instructor using the Performance Test on page 23.

NOTE:

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Connect scope to ignition system simulator.
2. Test primary ignition circuit.
3. Analyze engine performance with secondary voltage.
4. Perform spark plug firing voltage test.
5. Test distributor cap and rotor for voltage leaks.
6. Perform cylinder power balance test.
7. Test transistor and electronic ignition system.
8. Connect scope and interpret patterns.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	11

ENABLING OBJECTIVE NO. 1

3

RVTC

Connect scope to ignition system simulator.

LEARNING STEPS

1. Read Resource No. 1 and follow the steps to connect the scope to the simulator.
2. Using Resource No. 2 practice connecting the scope to the simulator.
3. Have your instructor inspect the scope hook-up.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. Text: Sun 2001 Operator's Manual, R-15 Tester, "Scope Hook-up Procedure".
2.
 - a. Sun scope
 - b. Ignition simulator
 - c. Text: Sun 2001 Operator's Manual
3. Instructor

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	11	1

ENABLING OBJECTIVE NO. 2
RVTC

Test primary ignition circuit.

LEARNING STEPS

1. Read Resource No. 1 to identify the function of the scope in testing the primary ignition system.
2. Evaluate your knowledge by completing Resource No. 2.
3. Read Resource No. 3 to identify the steps in recognizing primary ignition system problems.
4. As a Self-Check, complete Resource No. 4.
5. Practice identifying primary ignition problems. Have your instructor check your work.
6. Go on to Enabling Objective No. 3.

RESOURCES

1. Text: Engine Tune-up Service, Unit 3, pages 177 - 188.
2. Text: Review Exercise Book, Unit 3, Exercise 26, page 101.
3. Text: Engine Tune-up Service, Unit 3, pages 188 - 202.
4. Text: Review Exercise Book, Unit 3, Exercise 27, page 101.
5.
 - a. Scope
 - b. Ignition system simulator

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	11	2

ENABLING OBJECTIVE NO. 3
RVTC

Analyze engine performance with secondary voltage.

LEARNING STEPS

1. View Resource No. 1 to identify secondary system tested with the scope.
2. Read Resource No. 2 to identify the steps in analyzing the engine's secondary voltage.
3. Evaluate your knowledge by completing Resource No. 3.
4. Practice analyzing engine performance by completing Resource No. 4.
5. Go on to Enabling Objective No. 4.

RESOURCES

1. Hoffman slide/tape unit: 6.2.E.
2. Text: Engine Tune-up Service, Unit 4, pages 65 - 79.
3. Text: Review Exercise Book, Unit 4, Exercise 9.
4. Text: Engine Tune-up Service, Work Activity, items 1 and 2, page 80.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	11	3

ENABLING OBJECTIVE NO. 4

RVTC

Perform the spark plug firing voltage test.

LEARNING STEPS

1. Read Resource No. 1 to identify the steps in testing spark plug firing voltage.
2. Evaluate your knowledge by completing Resource No. 2.
3. Practice testing spark plug firing voltage by completing Resource No. 3.
4. Go on to Enabling Objective No. 5.

RESOURCES

1. Text: Engine Tune-up Service, Unit 4, pages 80 - 94.
2. Text: Review Exercise Book, Unit 4, Exercise 10, page 49.
3. Text: Engine Tune-up Service, Unit 4, Work Activity, page 94.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	11	4

ENABLING OBJECTIVE NO. 5

7

RVTC

Test distributor cap and rotor for voltage leaks.

LEARNING STEPS

1. Read Resource No. 1 to identify the steps in testing the distributor cap and rotor.
2. Evaluate your knowledge by completing Resource No. 2.
3. Practice testing the distributor cap and rotor by completing Resource No. 3.
4. See your instructor before going on to Enabling Objective No. 6.

RESOURCES

1. Text: Engine Tune-up Service, Unit 4, pages 95 - 100.
2. Text: Review Exercise Book, Unit 4, Exercise 11, page 57.
3. Text: Engine Tune-up Service, Work Activity, Unit 4, page 100.
4. Instructor

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	11	5

ENABLING OBJECTIVE NO. 6
RVTC

Perform cylinder power balance test.

LEARNING STEPS

1. Read Resource No. 1 to identify good and bad patterns related to the cylinder test.
2. Evaluate your knowledge by completing Resource No. 2.
3. Read Resource No. 3 to identify the process for performing a power balance test.
4. Evaluate your knowledge by completing Resource No. 4.
5. Practice performing cylinder power balance test by completing Resource No. 5.
6. Go on to Enabling Objective No. 7.

RESOURCES

1. Text: Engine Tune-up Service, Unit 4, pages 101 - 107.
2. Text: Review Exercise Book, Exercise 12, page 60 and Work Activity, page 107.
3. Text: Engine Tune-up Service, Unit 4, pages 111 - 120.
4. Text: Review Exercise Book, Unit 4, Exercises 13 and 14, pages 63 - 64.
5. Text: Engine Tune-up Service, Work Activities, pages 118 - 121.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	11	6

ENABLING OBJECTIVE NO. 7

RVTC

Test transistor and electronic ignition system.

LEARNING STEPS

1. Read Resource No. 1 to identify the procedure for testing transistor and electronic ignition.
2. Complete Resource No. 2 to evaluate your knowledge and practice testing transistor ignition system.
3. Read Resource No. 3 to identify scope patterns of electronic and transistor ignition systems.
4. Practice identifying and reading patterns of the electronic and transistor ignition systems.
5. When you think you can attain this task, take the Written Test.
6. Go on to Enabling Objective No. 8.

RESOURCES

1. Text: Engine Tune-up Service, Unit 4, pages 151 - 160.
2. a. Text: Review Exercise Book, Exercise 17, page 91.
b. Text: Engine Tune-up Service, Work Activity, page 161.
3. Text: Engine Tune-up Service, pages 161 - 171.
4. Text: Engine Tune-up Service, Unit 4, Work Activity, items 3 and 4, page 171.
5. Written Test for task C-11.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	11	7

WRITTEN TEST FOR TASK NO. C-11

RVTC

TASK:

Connect Scope and Interpret Patterns

DirectionsPAGE 1 OF 11

The purpose of this test is to determine if you can connect scope and interpret patterns. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Multiple choice. On the separate Answer Sheet, put the letter of the correct answer in the blank to the left of the number.

DO NOT MARK ON THIS TEST!

Multiple Choice questions

1. An open secondary ignition circuit is caused by a:
 - a. bad spark plug.
 - b. broken or separated spark plug wire.
 - c. lean fuel mixture.
 - d. cocked distributor cap.
2. The secondary ignition circuit insulation test is a test of:
 - a. the distributor cap.
 - b. the rotor.
 - c. the coil wire.
 - d. the spark plug wires.
 - e. all of these.
3. Normally, you would perform a cylinder leaking test when:
 - a. a cylinder balance test has shown poor results.
 - b. a compression test has shown good results.
 - c. a customer complains about loss of engine power.
 - d. the spark timing has been altered.
4. Which of the following facts about a secondary scope pattern for an electronic ignition-equipped Chrysler is true?
 - a. the firing line voltage is between 15 and 17 kv
 - b. there is an unusual "lump" in the dwell section
 - c. the dwell section of the waveform is curved and longer than normal
 - d. the waveform does not have a dwell section

DEPT.	PROG.	DUTY	TASK
IN	9043	C	11

WRITTEN TEST FOR TASK NO. C-11

RVTC

TASK:

Connect Scope and Interpret Patterns

PAGE 2 OF 11

5. Which of the following facts about a secondary scope pattern for a solid-state ignition-equipped Ford is true?
 - a. the firing lines are spaced closer together than normal
 - b. there is an unusual "lump" in the dwell section
 - d. the waveform has no dwell section
 - d. the firing line and firing time are the same
6. Which of the following facts about a secondary scope pattern for a high-energy ignition-equipped GM vehicle is true?
 - a. the waveform does not have a dwell section
 - b. the dwell section of the waveform is curved and longer than normal
 - c. the waveform has an unusual "lump" in the dwell section
 - d. the firing line and spark line are the same
7. Which of the conditions listed below would not indicate a possible malfunction in a transistor ignition system?
 - a. engine misses
 - b. vehicle exhaust emissions decrease
 - c. engine surges severely
 - d. engine will not start
8. The available voltage test on transistor ignition-equipped vehicles is performed by removing:
 - a. a spark plug wire and holding it to ground.
 - b. coil secondary wire and holding it to ground.
 - c. a spark plug wire and holding it away from ground.
 - d. removing coil secondary wire and holding it away from ground.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	11

WRITTEN TEST FOR TASK NO. C-11

RVTC

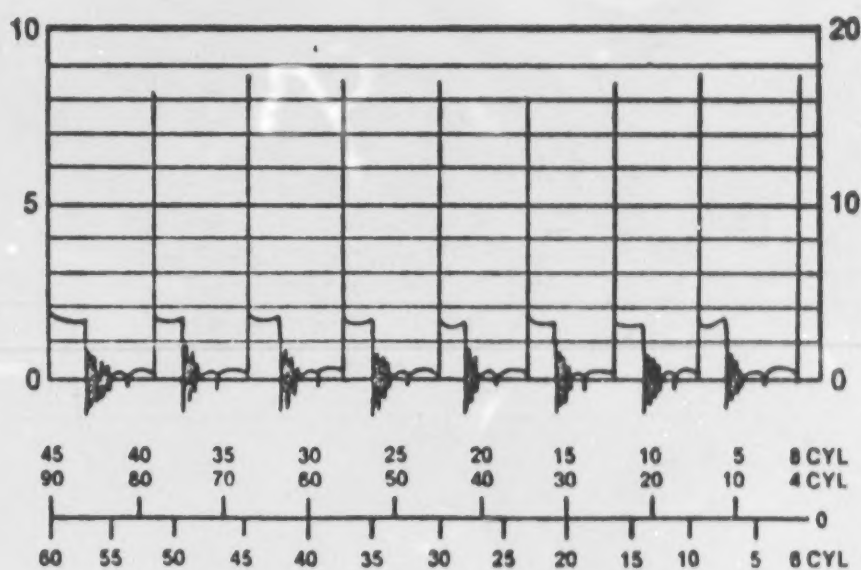
TASK:

Connect Scope and Interpret Patterns

PAGE 3 OF 11

9. The scope pattern below is the result of a spark plug firing voltage test using the 20 kv scale. Which does it indicate?

- a. good
b. bad



DEPT.	PROG.	DUTY	TASK
IN	9043	C	11

WRITTEN TEST FOR TASK NO. C-11

RVTC

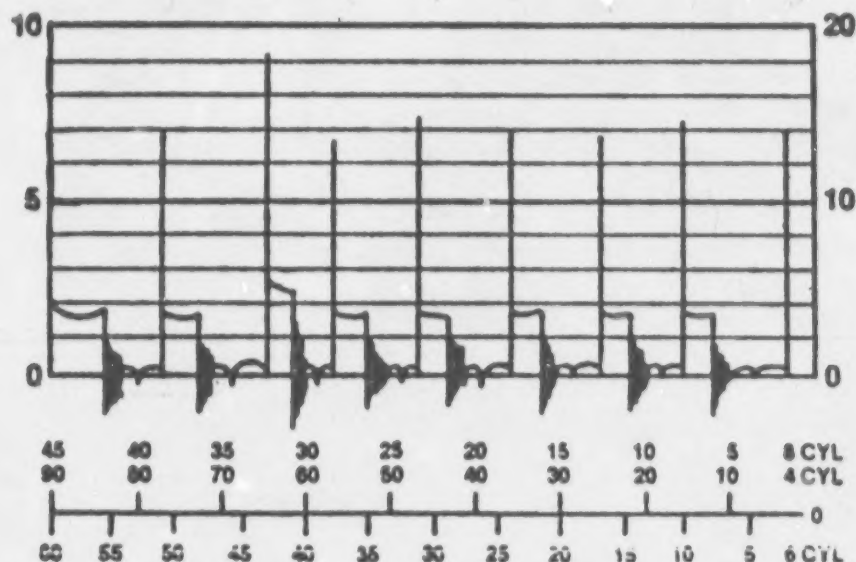
TASK:

Connect Scope and Interpret Patterns

PAGE 4 OF 11

10. The pattern shown in the illustration below shows the spark plug firing voltage (firing order 1-8-4-3-6-5-7-2). Which cylinder has a high firing line. The scope is not in the shift position.

- a. 1
- b. 2
- c. 3
- d. 4



11. In the pattern shown in the illustration above, the high firing line could be caused by:
- a. a widely gapped spark plug.
 - b. a worn spark plug.
 - c. a bad spark plug wire.
 - d. a defect in the distributor cap tower.
 - e. all of these.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	11

WRITTEN TEST FOR TASK NO. C-11

RVTC

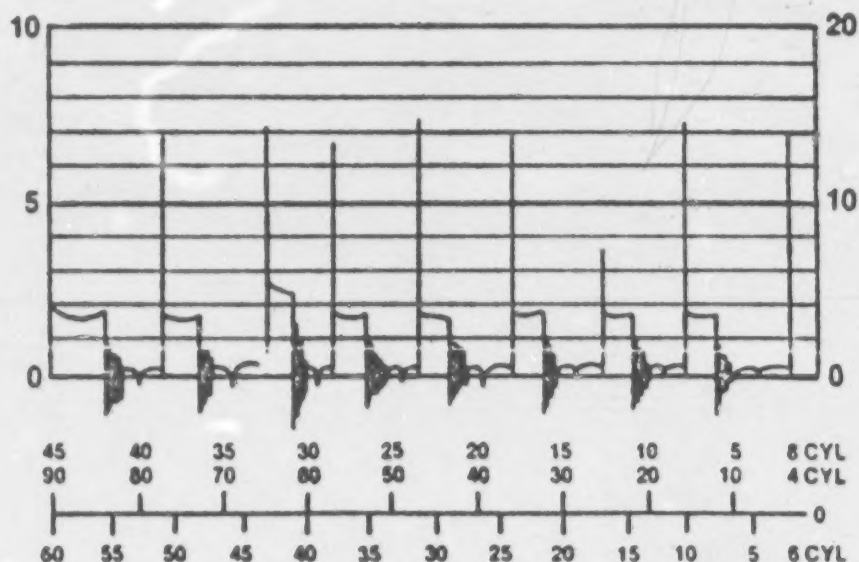
TASK:

Connect Scope and Interpret Patterns

PAGE 5 OF 11

12. The pattern shown in the illustration below shows the spark plug firing voltage (firing order 1-8-4-3-6-5-7-2). Which cylinder has a low firing line when the scope is not on the shift position.

- a. 5
b. 6
c. 7
d. 8



DEPT.	PROG.	DUTY	TASK
IN	9043	C	11

WRITTEN TEST FOR TASK NO. C-11

RVTC

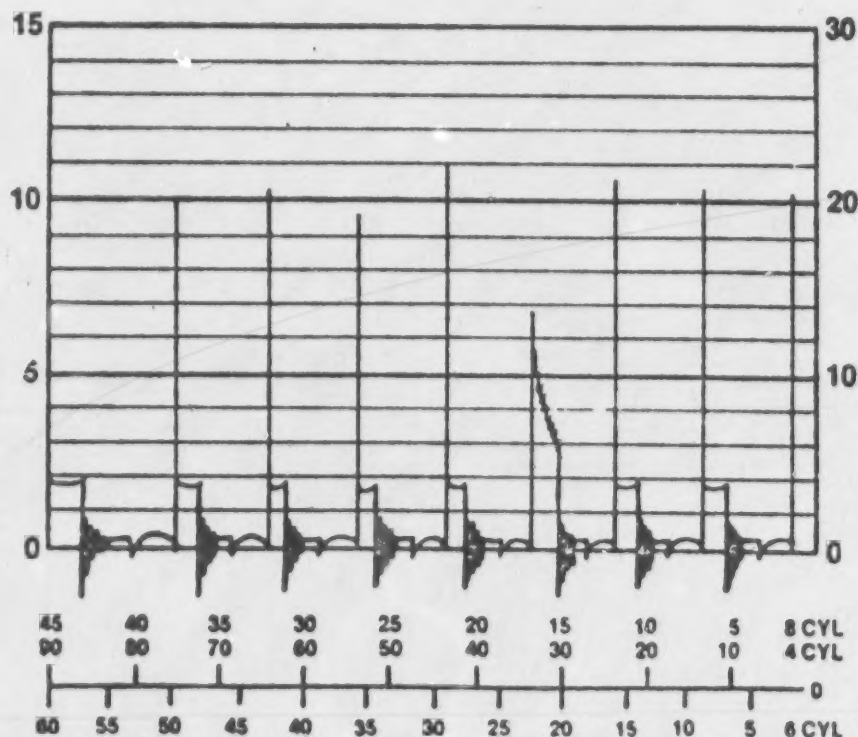
TASK:

Connect Scope and Interpret Patterns

PAGE 6 OF 11

13. What does the bad scope pattern in the illustration below indicate?

- a. bad plug wire
- b. fouled plug
- c. poor compression
- d. all the above



14. In the illustration above, which cylinder has the bad firing line, when the scope is not on the shift position (engine order is 1-8-4-3-6-5-7-2).

- a. 4
- b. 5
- c. 6
- d. 7

DEPT.	PROG.	DUTY	TASK
IN	9043	C	11

WRITTEN TEST FOR TASK NO. C-11

RVTC

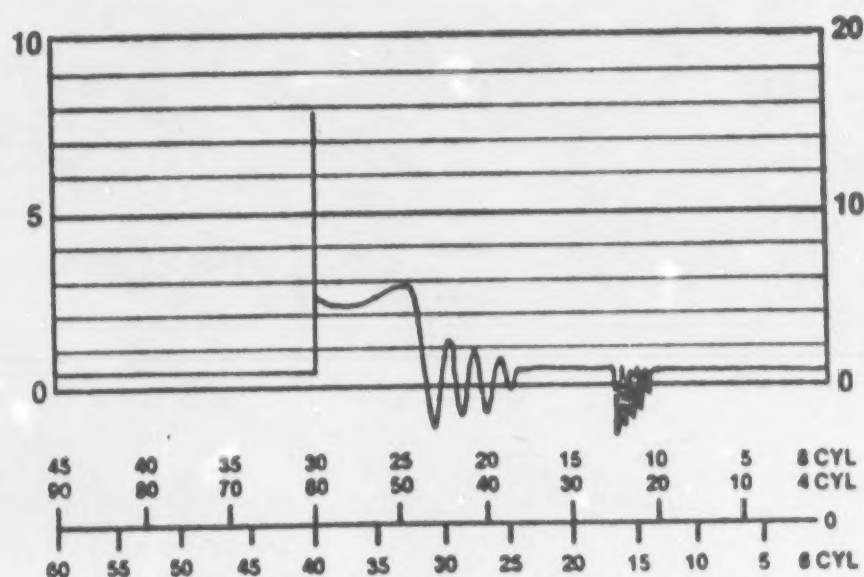
TASK:

Connect Scope and Interpret Patterns

PAGE 7 OF 11

15. What does the bad spark line illustrated below indicate (10 kv scale)?

- a. poor spark plug
- b. fuel starvation
- c. plug wire resistance
- d. coil weak



DEPT.	PROG.	DUTY	TASK
IN	9043	C	11

WRITTEN TEST FOR TASK NO. C-11

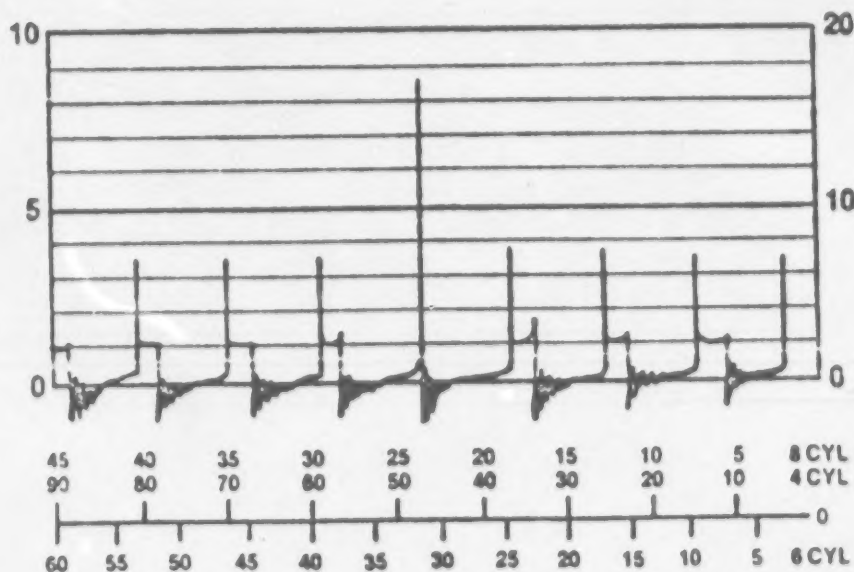
RVTC

TASK:

Connect Scope and Interpret Patterns

PAGE 8 OF 11

16. Look at the following pattern from an available voltage test. This waveform indicates that:
- there is a problem in the transistor ignition system.
 - there is no problem in the transistor ignition system.



DEPT.	PROG.	DUTY	TASK
IN	9043	C	11

WRITTEN TEST FOR TASK NO. C-11

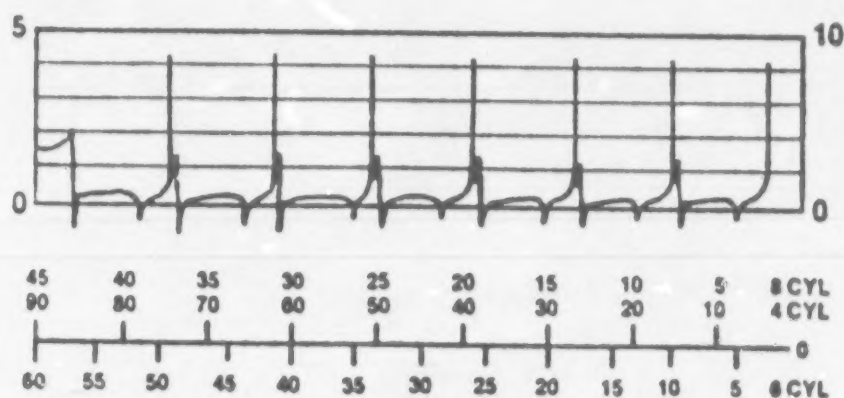
RVTC

TASK:

Connect Scope and Interpret Patterns

PAGE 9 OF 11

17. Look at the following pattern from a spark plug voltage test. This pattern indicates that:
- there is a problem in the transistor ignition system.
 - some spark plugs are fouled or very worn.
 - some spark plugs have too narrow a gap.
 - there are no problems in the transistor ignition system.



DEPT.	PROG.	DUTY	TASK
IN	9043	C	11

WRITTEN TEST FOR TASK NO. C-11

RVTC

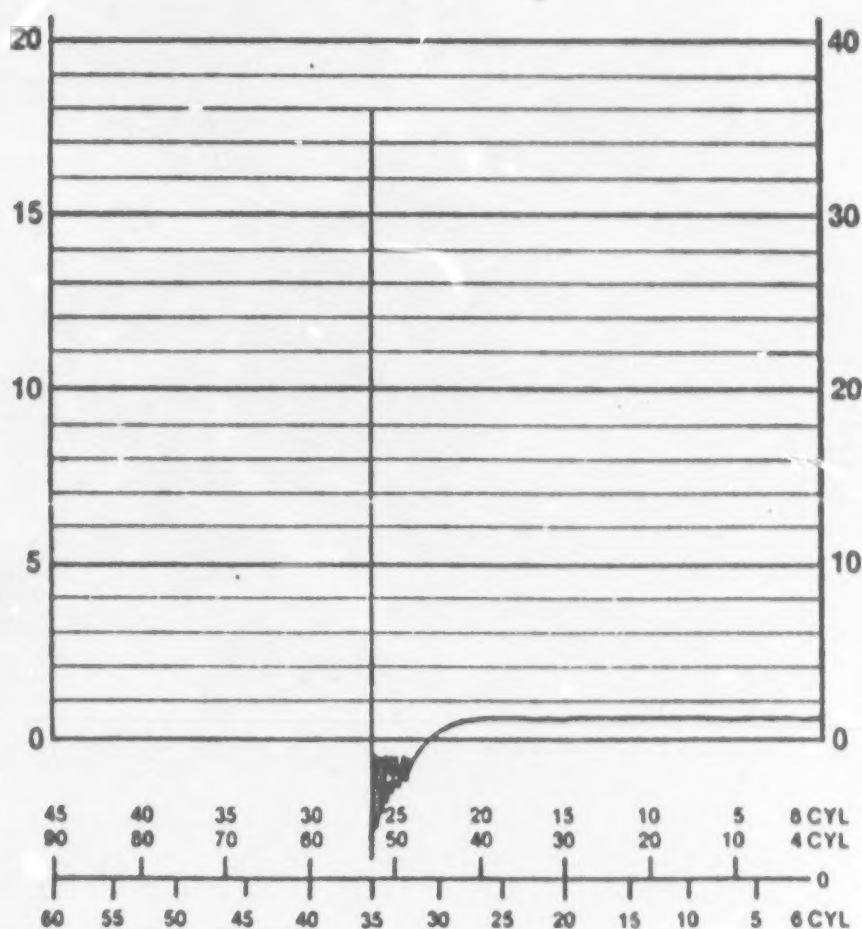
TASK:

Connect Scope and Interpret Patterns

PAGE 10 OF 11

18. Look at the following pattern from a cranking coil output test. This pattern indicates that: (40 kv scale)

- there is a problem in the transistor ignition system.
- there is no problem in the transistor ignition system.



DEPT.	PROG.	DUTY	TASK
IN	9043	C	11

WRITTEN TEST FOR TASK NO. C-11

RVTC

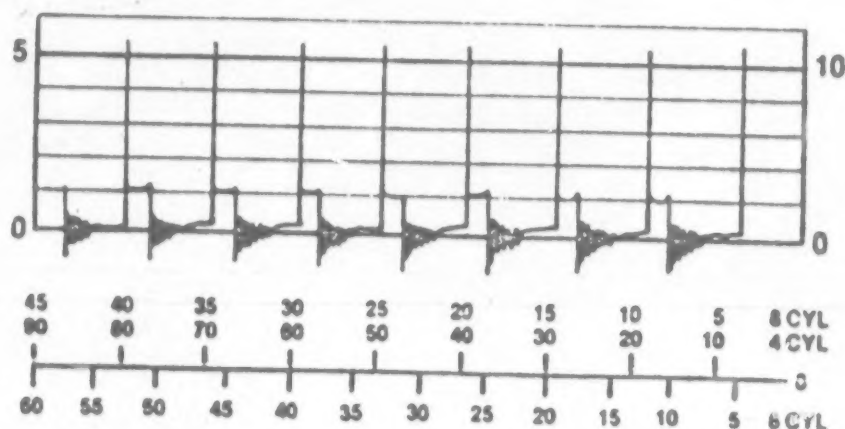
TASK:

Connect Scope and Interpret Patterns

PAGE 11 OF 11

19. Identify the kind of transistor ignition system that has this display pattern:

- a. H-E-I- General Motors
- b. Ford, Solid State
- c. Chrysler-Transistor IGN. SYS.
- d. AMC, BID



DEPT.	PROG.	DUTY	TASK
IN	9043	C	11

WRITTEN TEST FOR TASK NO. C-11

RVTC

TASK:

Connect Scope and Interpret Patterns

ANSWER KEY

PAGE 1 OF 1Multiple Choice questions

<u>b</u> 1.	<u>c</u> 6.	<u>e</u> 11.	<u>a</u> 16.	<u> </u> 21.
<u>d</u> 2.	<u>b</u> 7.	<u>c</u> 12.	<u>d</u> 17.	<u> </u> 22.
<u>a</u> 3.	<u>c</u> 8.	<u>b</u> 13.	<u>b</u> 18.	<u> </u> 23.
<u>d</u> 4.	<u>b</u> 9.	<u>b</u> 14.	<u>a</u> 19.	<u> </u> 24.
<u>d</u> 5.	<u>d</u> 10.	<u>b</u> 15.	<u> </u> 20.	<u> </u> 25.

True-False questions

T F 1.	T F 6.	T F 11.	T F 16.	T F 21.
T F 2.	T F 7.	T F 12.	T F 17.	T F 22.
T F 3.	T F 8.	T F 13.	T F 18.	T F 23.
T F 4.	T F 9.	T F 14.	T F 19.	T F 24.
T F 5.	T F 10.	T F 15.	T F 20.	T F 25.

Matching questions

<u> </u> 1.	<u> </u> 6.	<u> </u> 11.	<u> </u> 16.	<u> </u> 21.
<u> </u> 2.	<u> </u> 7.	<u> </u> 12.	<u> </u> 17.	<u> </u> 22.
<u> </u> 3.	<u> </u> 8.	<u> </u> 13.	<u> </u> 18.	<u> </u> 23.
<u> </u> 4.	<u> </u> 9.	<u> </u> 14.	<u> </u> 19.	<u> </u> 24.
<u> </u> 5.	<u> </u> 10.	<u> </u> 15.	<u> </u> 20.	<u> </u> 25.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	11

ENABLING OBJECTIVE NO. 8
RVTC

Connect scope and interpret patterns.

LEARNING STEPS

1. Practice connecting scope and interpreting patterns.
2. When you think you can perform this task, take the Performance Test.

RESOURCES

1.
 - a. Scope R-15 and Engine Ignition System Simulator
 - b. Scope R-15 or 2001 Computer and Test Vehicle Standard Ignition System
 - c. Scope R-15 or 2001 Computer and Test Vehicle with Electronic Ignition
2. Performance Test for task C-11.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	11	8

PERFORMANCE TEST FOR TASK NO. C-11

RVTC

IN-9043-C-11

TASK:

Connect Scope and Interpret Patterns

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will connect scope and interpret patterns. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO	
1.	Was the scope connected as outlined in the operator's manual?			
2.	Was the engine idle, mixture and dwell checked?			
3.	Was the secondary circuit checked?			
4.	Were any defects listed?			
5.	Was coil voltage checked?			
6.	Was plug firing voltage checked and recorded?			
7.	Was the distributor cap and rotor checked and recorded?			
8.	Were related problems of the combustion chamber, fouled plug, leaking exhaust valves or fuel starvation checked for and recorded?			
9.	Were the correct tools used?			
10.	Were tools returned to the tool room?			
11.	Were safety precautions followed?			
☐ ATTAINED ☐ NOT ATTAINED		EVALUATOR'S SIGNATURE _____		
Score _____				
DEPT.	PROG.	DUTY	TASK	ATTEMPT
IN	9043	C	11	
				Page <u>1</u> of <u>1</u>

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VO-TECH CENTER

7700 State Road 544 N
Winter Haven, Florida 33880

IN-9043-C-10

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Describe Scope Hook-up and Identify Patterns

DUTY:

Troubleshooting and Repairing Electrical System

PURPOSE :

Modern automobiles are equipped with systems and components that require precision servicing and testing. The scope is an electrical test computer which evaluates engine system problems. This Learning Guide will describe how to hook-up the scope to the engine and identify the patterns on the screen.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	C	10	A, B

REVISED

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:****GIVEN:**

YOU WILL: describe Scope hook-up and identify patterns for various tests.

HOW WELL: You must successfully complete the Written Test.

ENABLING OBJECTIVES:

1. Describe Scope face.
2. Identify Analog ignition controls.
3. Describe Scope hook-up to ignition.
4. Identify scope patterns.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	10

ENABLING OBJECTIVE NO. 1

RVTC

Describe Scope face.

LEARNING STEPS

1. View Resource No. 1 to identify the face of the scope.
2. Read Resource No. 2 to identify scales and lines of the scope face.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. Hoffman slide/tape units:
3.20.1 and 3.20.2.
2. Instruction Sheet enclosed,
The Scope Face
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	10	1

INSTRUCTION SHEET

4
RVTC

PAGE 1 OF 2

The Scope Face

1. The face of the Scope is scaled to permit measurements of ignition voltage valves to be viewed on a screen, coil voltage and dwell can also be seen. See Figure 1-1.
2. The left edge of the screen provides a range from 0 to 25 volts or 0 to 25 kv (kv = 1000 volts). See Figure 1-2.
3. The vertical scale on the right side reads from 0 volts to 50 or 0 kv to 50 kv secondary voltage and 0 to 500 volts primary. See Figure 1-3.
4. This scale is for dwell readings for eight cylinder engines when reading 0 to 45°. The 0 to 90° is for four cylinder engines and 0 to 60° for six cylinder engines. See Figure 1-4.
5. The lights at the bottom of the scope are 25 kv, 25v, 50 kv and 500v. These lights help to remind the operator which scale is now in use. See Figure 1-5.

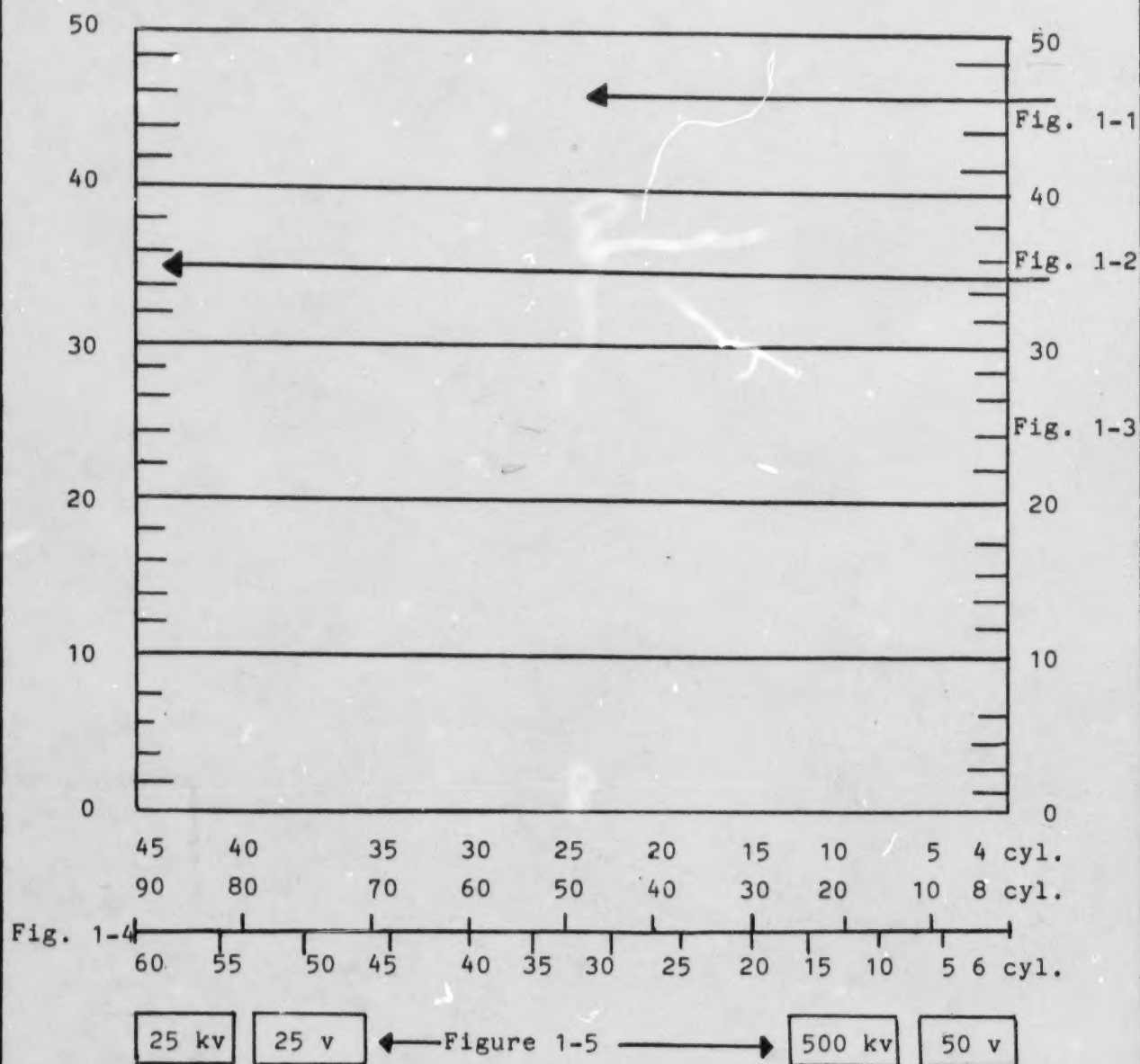
DEPT.	PROC	DUTY	TASK	EN OBJ.
IN	9043	C	10	1

INSTRUCTION SHEET

5

RVTC

PAGE 2 OF 2



DEPT.	PROG.	DUTY	TASK	EN OBJ.
IN	9043	C	10	1

SELF-CHECK**RVTC**Directions

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. The Scope face records voltage from the ignition system.
2. The left side of the screen is used to measure voltage of an ignition coil.
3. The 10 kv line represents 10,000 volts.
4. Dwell is measured at the bottom of the Scope face.
5. The right side of the Scope face is for high voltage only.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	10	1

SELF-CHECK

RVTC

Answer Key

1. T
2. F
3. T
4. T
5. T

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	10	1

ENABLING OBJECTIVE NO. 2
RVTC

Identify Analog ignition controls.

LEARNING STEPS

1. Read Resource No. 1 to identify the Scope Analog controls.
2. Evaluate your knowledge by completing the Self-Check.
3. Go on to Enabling Objective NO. 3.

RESOURCES

1. Instruction Sheet enclosed, Analog Ignition Scope Controls
2. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	10	2

INSTRUCTION SHEET

9

RVTC

PAGE 1 OF 2

Analog Ignition Scope Controls

1. Behind the hinged panel (Fig. 2-1) are five controls which adjust the scope (A) brightness (B) vertical position (C) horizontal position and (D) length of scope wave form.
NOTE: These adjustments are to be set by your instructor.
2. The Function Selector (Fig. 2-2) is a four position switch used to select the wave form that is to be displayed on the scope.
3. The Coil Test Knob (Fig. 2-3) has two positions which are used to test all types of coils.
4. The Pattern Height Control (Fig. 2-4) is used to select the vertical height of the wave form displayed on the scope. Low position 0 - 25 kv and High position 0 - 50 kv. The variable position allows a variable adjustment to be made.
5. Variable adjustment knob (Fig. 2-5) allows a manual adjustment of the height of the pattern made when the Height Control Knob (Fig. 2-4) is in the variable position.
6. The Pattern Selector Knob (Fig. 2-6) selects the type of wave form which is to appear on the screen.
A -- Display B -- Raster C -- Superimposed
7. The Pattern Position Switch (Fig. 2-7) allows the No. 1 cylinder firing line to appear at the left of the Scope or at the right side of the Scope.
8. The Cylinder Select Buttons (Fig. 2-8) are used to select one or any number of cylinders to appear on the Scope or to cancel one or any number of cylinders out of the firing order.
9. The Cylinder Select Mode Buttons (Fig. 2-9) are used in conjunction with the Cylinder Select Buttons to compare the power of each cylinder of the system.
10. The Sweep Rate Adjust Knob (Fig. 2-10) is used only when special patterns are tested. This knob synchronizes the Scope Sweep with the speed of the engine.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	10	2

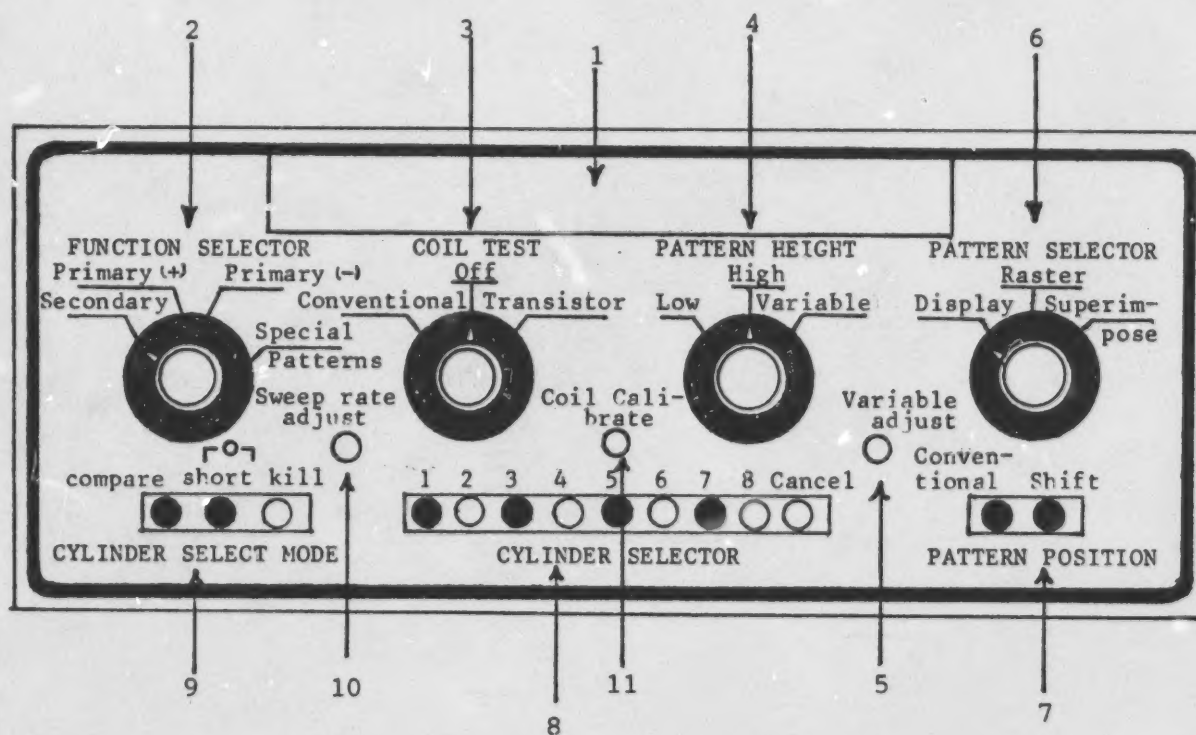
INSTRUCTION SHEET

RVTC

PAGE 2 OF 2

11. The Coil Calibrate Control (Fig. 2-11) adjusts the input of the ignition coil being tested and is used only when the Coil Test Knob is held in the test position.

NOTE: This is a brief description of the control knobs of the Analog Section, for a thorough description of the operation, refer to the Operator's Manual, Sun 2001 Diagnostic Computer.



DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	10	2

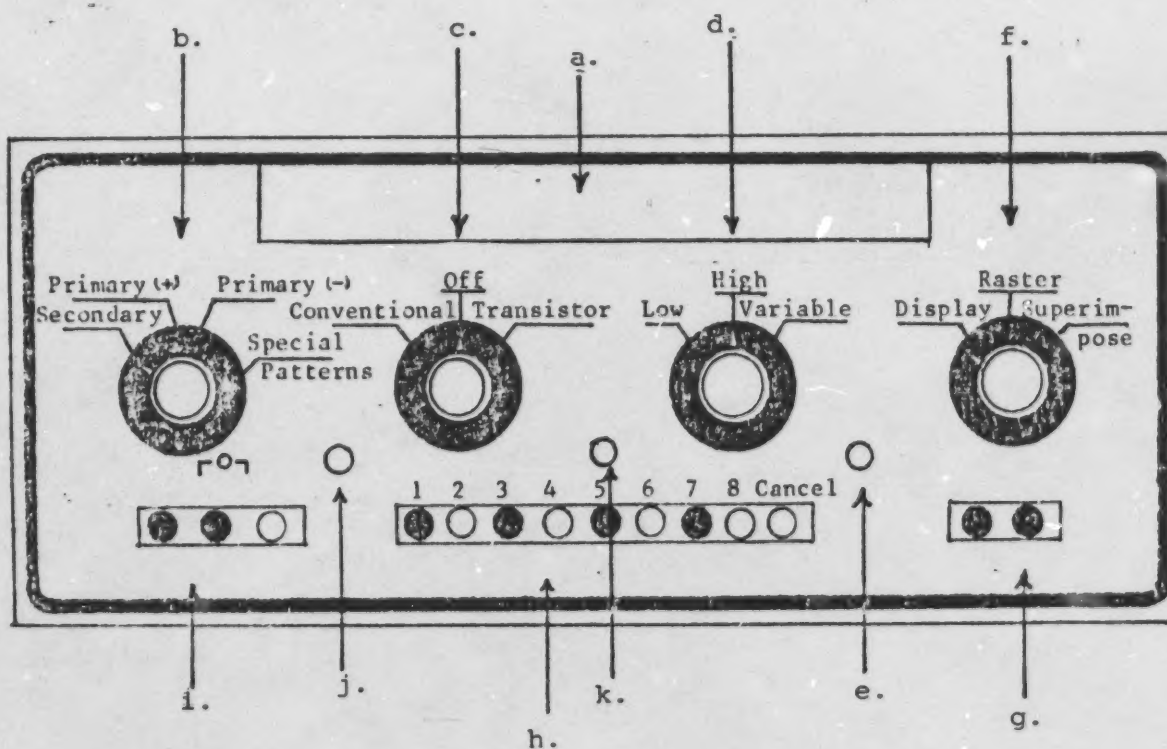
SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. Pattern height
2. Coil test
3. Function selector
4. Cylinder select mode
5. Coil calibrate
6. Pattern selector
7. Pattern position
8. Cylinder selector
9. Variable Adjust
10. Sweep rate



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	10	2

SELF-CHECK**RVTC**Answer Key

1. d
2. c
3. b
4. i
5. k
6. f
7. g
8. h
9. e
10. j

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	10	2

ENABLING OBJECTIVE NO. 3

RVTC

Describe Scope hook-up on engine.

LEARNING STEPS

1. Read Resource No. 1 to identify the procedure for setting up the Scope for hook-up.
2. Read Resource No. 2 to identify the connections to be made on the test engine.
3. Read Resource No. 3 to identify the sequence of the Scope hook-up.
4. Evaluate your knowledge by completing the Self-Check.
5. Go on to Enabling Objective No. 4.

RESOURCES

1. Text: Sun 2001 Diagnostic Computer, page 13.
2. Text: Sun 2001 Diagnostic Computer, page 13.
3. Text: Sun 2001 Diagnostic Computer, page 12.
4. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	10	3

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by matching the items below on a separate sheet of paper.

- | | |
|----------------------------|-----------------------------------|
| 1. Black boot on blue lead | a. intake manifold |
| 2. Red clamp on blue lead | b. negative side of coil |
| 3. Red secondary lead | c. alternator battery post |
| 4. Red twin flex lead | d. coil wire (secondary) |
| 5. Green clamp | e. engine ground |
| 6. Green boot | f. battery |
| 7. Vacuum lead | g. negative battery terminal wire |
| 8. Exhaust probe | h. positive coil wire |
| 9. Chrome clamp | i. No. 1 plug wire |
| | j. tailpipe |

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	10	3

SELF-CHECK**RVTC**Answer Key

1. e
2. b
3. i
4. f
5. g
6. c
7. a
8. j
9. d

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	10	3

ENABLING OBJECTIVE NO. 4
RVTC

Identify Scope patterns.

LEARNING STEPS

1. Read Resource No. 1 to identify Scope patterns.
2. Attend Resource No. 2 to practice identifying Scope patterns.
3. When you think you can attain this task, take the Written Test.

RESOURCES

1. Text: Engine Tune-up Service, Unit 4, "Secondary Circuit", pages 69 - 76.
2. Instructor Demonstration
3. Written Test for task C-10.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	10	4

WRITTEN TEST FOR TASK NO. C-10

RVTC

TASK:

Describe Scope Hook-up and Identify Patterns

IN-9043-C-10

DirectionsPAGE 1 OF 3

The purpose of this test is to determine if you fully understand how to describe scope hook-up and identify patterns. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Multiple Choice. On the separate Answer Sheet, put the letter of the correct answer in the blank to the left of the number of the question.

DO NOT MARK ON THIS TEST!

Multiple Choice questions

1. The face of the Scope is scaled to:
 - a. record alternator output.
 - b. record ignition voltage.
 - c. 1/4" per 1'.
 - d. amperage of the ignition system.
2. 50 kv represents:
 - a. 50 kilograms.
 - b. 50 volts.
 - c. 50,000 volts.
 - d. 5,000 volts.
3. Dwell is recorded:
 - a. to the left side of the Scope.
 - b. to the right side of the Scope.
 - c. at the bottom of the Scope.
 - d. at the top of the Scope.
4. The red clamp on the ignition harness is connected to the:
 - a. coil wire.
 - b. no. 1 spark plug wire.
 - c. positive battery terminal.
 - d. ground.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	10

WRITTEN TEST FOR TASK NO. C-10

RVTC

TASK:

Describe Scope Hook-up and Identify Patterns

PAGE 2 OF 3

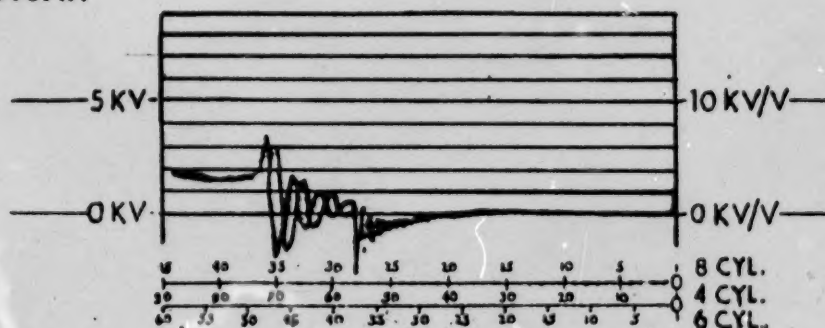
IN-9043-C-10

5. The green clamp is connected to the:

- a. positive battery terminal.
- b. negative battery terminal.
- c. ground.
- d. alternator terminal.

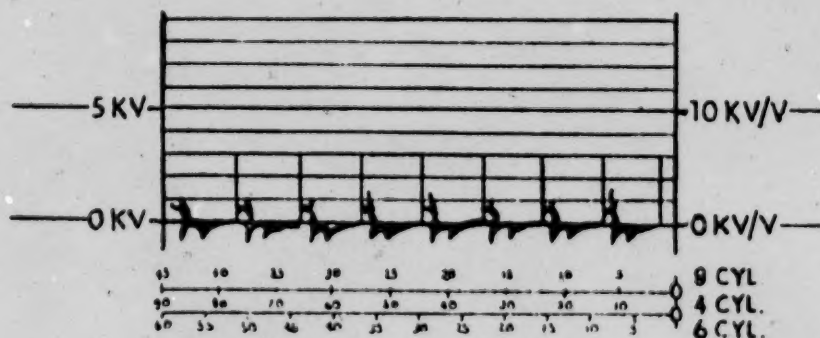
6. This picture shows a:

- a. superimposed pattern.
- b. display pattern.
- c. raster pattern.
- d. parade pattern.



7. This picture shows a:

- a. superimposed pattern.
- b. display pattern.
- c. raster pattern.
- d. stack pattern.



DEPT.	PROG.	DUTY	TASK
IN	9043	C	10

WRITTEN TEST FOR TASK NO. C-10

RVTC

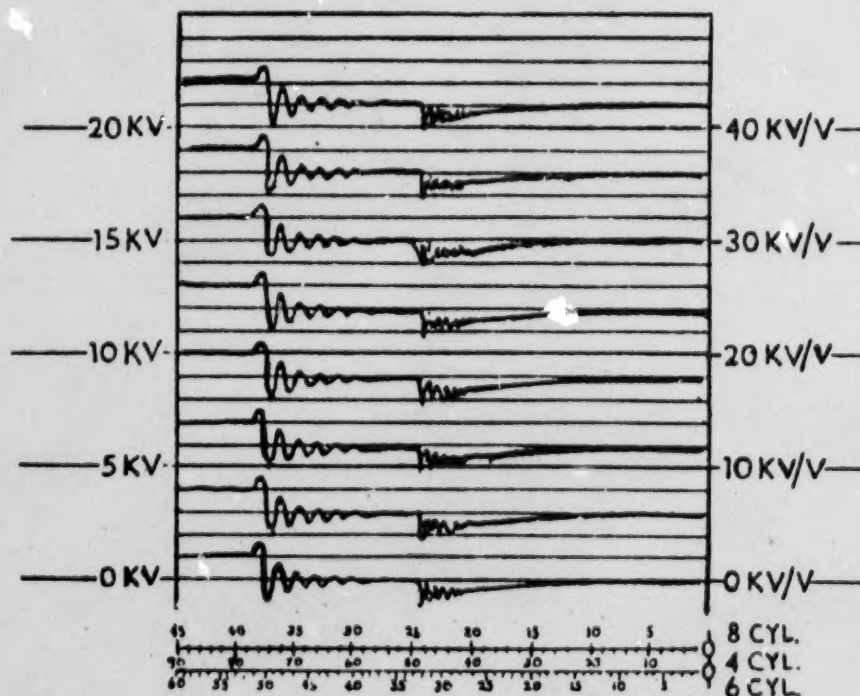
TASK:

Describe Scope Hook-up and Identify Patterns

PAGE 3 OF 3

8. This pattern is a:

- a. superimposed pattern.
- b. display pattern.
- c. raster pattern.
- d. parade pattern.



9. The red boot on the blue lead is connected to the:

- a. positive side of the coil.
- b. negative side of the coil.
- c. positive battery terminal.
- d. alternator terminal.

10. The twin flex lead is connected to the:

- a. negative coil post.
- b. battery posts.
- c. no. 1 plug wire.
- d. coil wire.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	10

WRITTEN TEST FOR TASK NO. C-10

RVTC

IN-9043-C-10

TASK:

Describe Scope Hook-up and Identify Patterns

ANSWER KEY

PAGE 1 OF 1Multiple Choice questions

- | | | | | |
|-------------|--------------|---------|---------|---------|
| <u>b</u> 1. | <u>a</u> 6. | ___ 11. | ___ 16. | ___ 21. |
| <u>c</u> 2. | <u>b</u> 7. | ___ 12. | ___ 17. | ___ 22. |
| <u>c</u> 3. | <u>c</u> 8. | ___ 13. | ___ 18. | ___ 23. |
| <u>b</u> 4. | <u>b</u> 9. | ___ 14. | ___ 19. | ___ 24. |
| <u>b</u> 5. | <u>b</u> 10. | ___ 15. | ___ 20. | ___ 25. |

True-False questions

- | | | | | |
|--------|---------|---------|---------|---------|
| T F 1. | T F 6. | T F 11. | T F 16. | T F 21. |
| T F 2. | T F 7. | T F 12. | T F 17. | T F 22. |
| T F 3. | T F 8. | T F 13. | T F 18. | T F 23. |
| T F 4. | T F 9. | T F 14. | T F 19. | T F 24. |
| T F 5. | T F 10. | T F 15. | T F 20. | T F 25. |

Matching questions

- | | | | | |
|--------|---------|---------|---------|---------|
| ___ 1. | ___ 6. | ___ 11. | ___ 16. | ___ 21. |
| ___ 2. | ___ 7. | ___ 12. | ___ 17. | ___ 22. |
| ___ 3. | ___ 8. | ___ 13. | ___ 18. | ___ 23. |
| ___ 4. | ___ 9. | ___ 14. | ___ 19. | ___ 24. |
| ___ 5. | ___ 10. | ___ 15. | ___ 20. | ___ 25. |

DEPT.	PROG.	DUTY	TASK
IN	9043	C	10

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VO-TECH CENTER

7700 State Road 544 N
Winter Haven, Florida 33880

IN-9043-C-09

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Identify Starting System Components and Describe Operation

DUTY:

Troubleshooting and Repairing Electrical System

PURPOSE :

The starting system requires periodic servicing and repair. Therefore, it is necessary to have a working knowledge of the system and how it operates. Accurate diagnosis and repair will boost business.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	C	09	C-08

REVISED :

STUDENT PERFORMANCE OBJECTIVES:

2
RVTC

TERMINAL PERFORMANCE OBJECTIVE:

GIVEN: a 1978 Chevy test engine,

YOU WILL: identify the starting system components and describe operation.

HOW WELL: You must successfully complete the Written Test.

NOTE:

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Identify starting system components.
2. Describe the operation of starting system.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	09

ENABLING OBJECTIVE NO. 1

RVTC

Identify starting system components.

LEARNING STEPS

1. Read Resource No. 1 to identify starting system components.
2. Using Resource No. 2, practice identifying starting system components.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. Text: Engine Tune-up Service, Unit 1, pages 8 - 12.
2. 1978 Chevy test engine
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	09	1

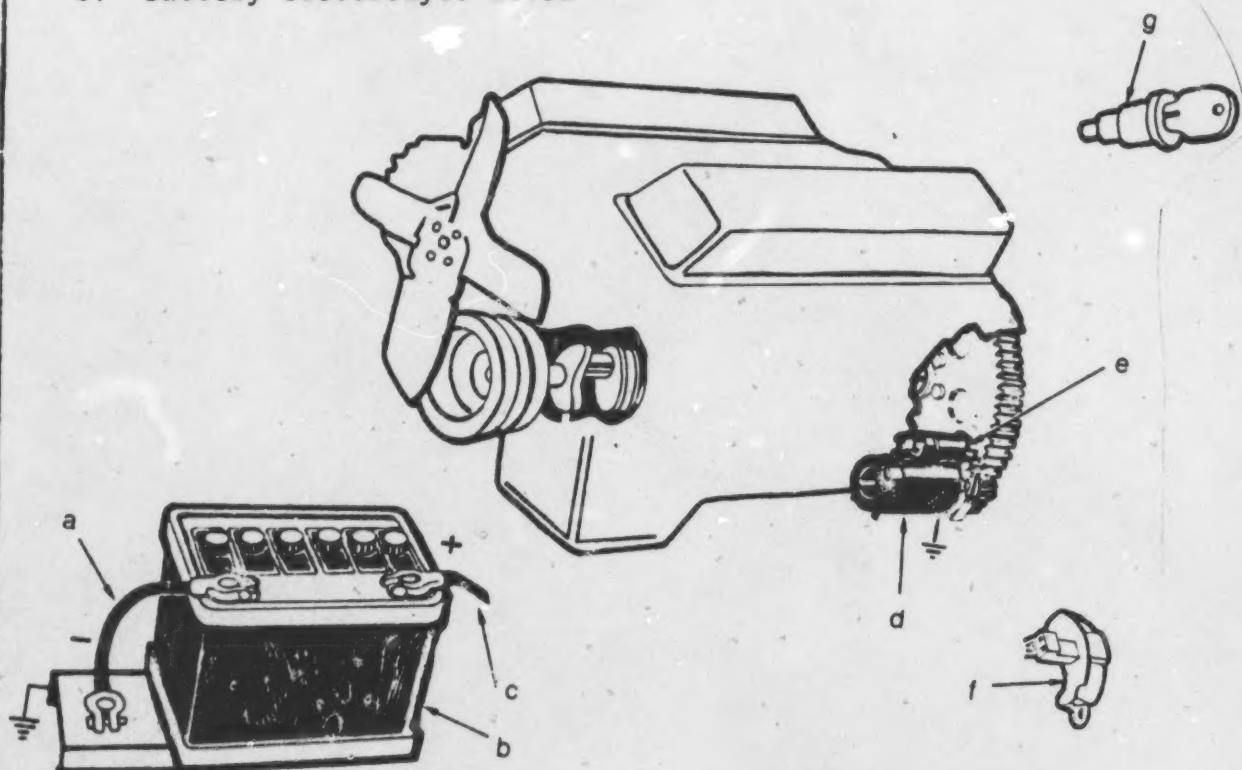
SELF-CHECK

RVTC

Directions

Evaluate your knowledge by matching the items below with the diagram on a separate sheet of paper.

1. battery positive cell
2. solenoid switch
3. ignition switch
4. battery
5. neutral safety switch
6. starter motor
7. battery ground cable
8. battery electrolyte level



DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	09	1

SELF-CHECK

RVTC

Answer Key

1. battery ground cable
2. battery
3. battery positive cable
4. starter motor
5. solenoid switch
6. neutral safety switch
7. ignition switch

Multiple Choice

1. d
2. b
3. b

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	09	I

ENABLING OBJECTIVE NO. 2
RVTC

Describe the operation of starting system.

LEARNING STEPS

1. View Resource No. 1 describing the operation of a starting engine.
2. Using Resource No. 2, practice describing the operation of a starting system.
3. Evaluate your knowledge by completing the Self-Check.
4. When you think you can attain this task, take the Written Test.

RESOURCES

1. Hoffman slide/tape unit: 4.7.A.
2. Ignition and Starting System Simulator
3. Self-Check enclosed.
4. Written Test for task C-09.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	09	2

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

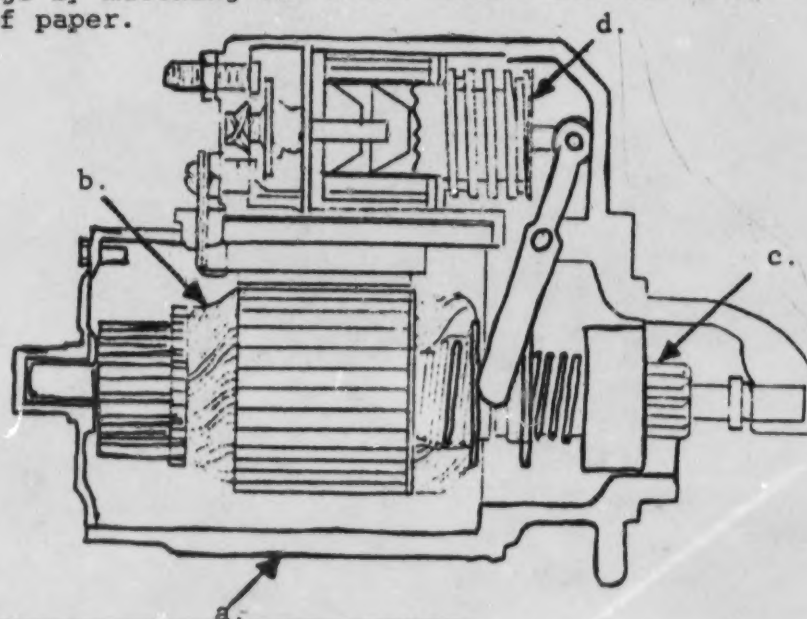
1. Which of the following is not a component of the starting system?
 - a. battery
 - b. ignition switch
 - c. starter motor
 - d. ignition coil
2. Which solenoid draws more current?
 - a. overrunning clutch solenoid
 - b. Bendix drive solenoid
 - c. airheart drive solenoid
 - d. none of the above

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. The two circuits that comprise the starting circuits are the actuating and power circuits.
2. The solenoid used with Bendix drive closes the circuit to supply power to drive the starter motor and operates a lever to shift the overrunning clutch drive unit.

Evaluate your knowledge by matching the items below with the diagram on a separate sheet of paper.

1. solenoid
2. field frame
3. armature
4. drive



DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	09	2

SELF-CHECK

RVTC

Answer Key

1. e

2. a

True-False

1. F

2. F

Matching

1. d

2. a

3. b

4. c

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	09	2

WRITTEN TEST FOR TASK NO. C-09

RVTC

IN-9043-C-09

TASK:

Identify Starting System Components and Describe Operation

DirectionsPAGE 1 OF 4

The purpose of this test is to determine if you can identify starting system components and describe operation. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are True-False. On the separate Answer Sheet, circle the T if the item is True and the F if the item is False.

DO NOT MARK ON THIS TEST!

True-False questions

1. The starting system circuit includes the ignition switch, battery, solenoid and the generator-regulator.
2. The battery controls the actuating circuit.
3. The field of a starter and armature are said to be examples of an electromagnet.
4. The battery is a good place to start when doing a visual check on the starting system.

The items below are Multiple Choice. On the separate Answer Sheet, put the letter of the correct answer in the blank to the left of the number.

1. Which of the following instruments do we use to test the starting circuit?
 - a. volt-amp tester
 - b. battery charger
 - c. test light
 - d. timing light
2. Which of the following is not a part of the cranking motor drive?
 - a. flywheel
 - b. solenoid
 - c. shifting yoke
 - d. overrunning clutch

DEPT.	PROG.	DUTY	TASK
IN	9043	C	09

WRITTEN TEST FOR TASK NO. C-09

RVTC

IN-9043-C-09

TASK:

Identify Starting System Components and Describe Operation

PAGE 2 OF 4

3. Which of the following is not a part of the cranking motor?
 - a. brushes
 - b. fields
 - c. regulator
 - d. armature
4. Which of the following is not a part of the cranking motor control circuit?
 - a. solenoid
 - b. transmission-neutral switch
 - c. ignition switch
 - d. overrunning clutch
5. The device on the armature shaft that is made of segments is called a:
 - a. winding.
 - b. connector.
 - c. commutator.
 - d. coil.
6. In most starting motors, the motor terminal is connected to the:
 - a. ground.
 - b. field windings.
 - c. armature.
 - d. brushes.
7. The starting motors, must have very low resistance so that:
 - a. current will be low.
 - b. voltage will be kept low.
 - c. heavy current will flow.
 - d. less copper will be required.
8. Starter motor armatures are wound with:
 - a. heavy cotton-covered wire.
 - b. heavy ribbon-type conductors.
 - c. resistance wire.
 - d. commutator.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	09

WRITTEN TEST FOR TASK NO. C-09

RVTC

IN-9043-C-09

TASK:

Identify Starting System Components and Describe Operation

PAGE 3 OF 4

The items below are Matching. On the separate Answer Sheet, match the items below with the diagram on the following page.

1. Element
2. Commutator
3. Plunger
4. Terminal
5. Brushes
6. Case
7. Armature
8. Bushing
9. Battery terminal
10. Contact disc
11. Pinion gear
12. Seperator
13. Field Windings
14. Pole shoe
15. Drive clutch

DEPT.	PROG.	DUTY	TASK
IN	9043	C	09

WRITTEN TEST FOR TASK NO. C-09

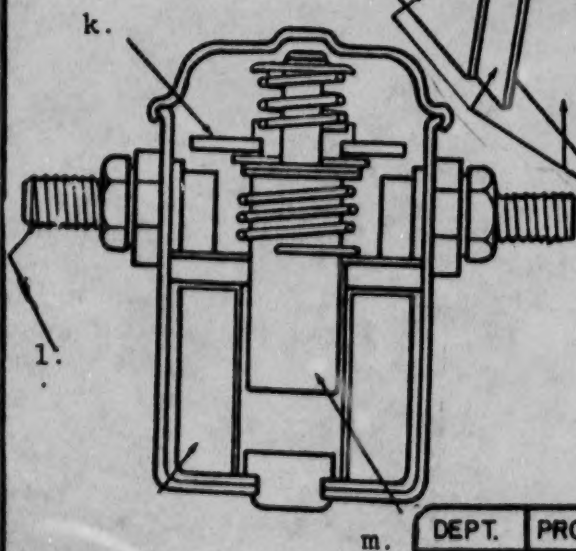
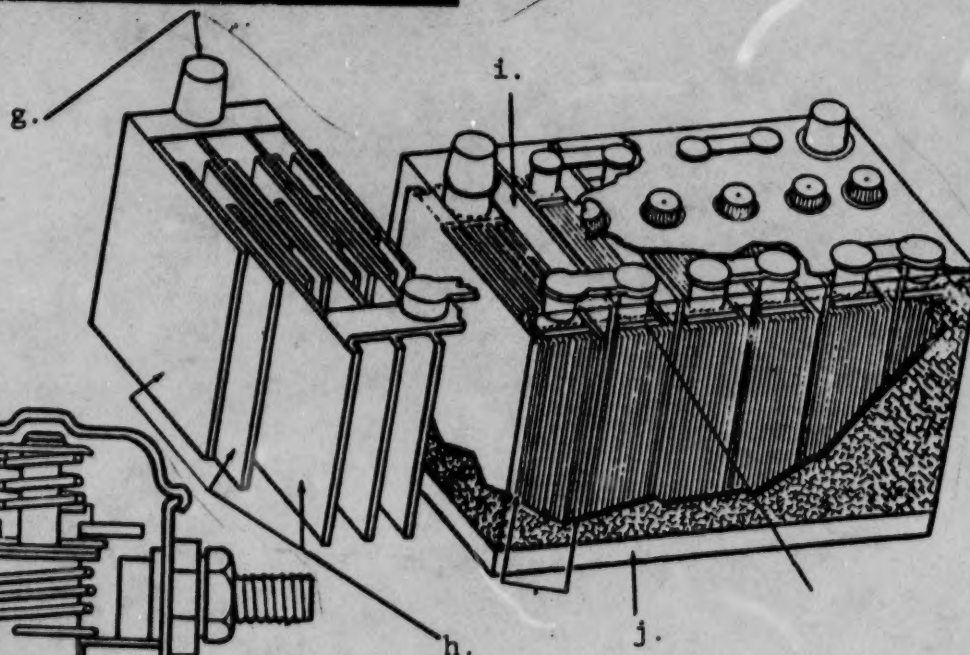
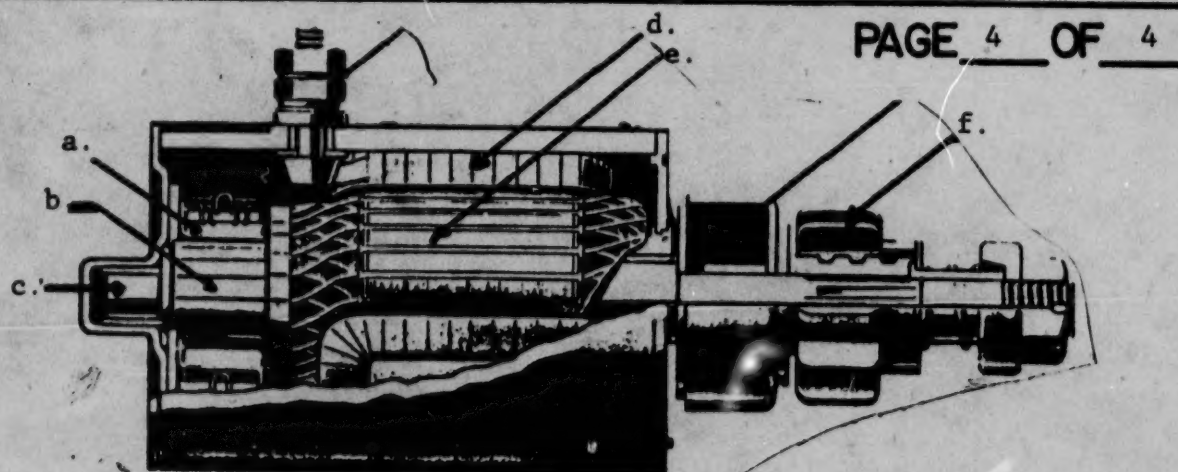
RVTC

IN-9043-C-09

TASK:

Identify Starting System Components and Describe Operation

PAGE 4 OF 4



DEPT.	PROG.	DUTY	TASK
IN	9043	C	09

WRITTEN TEST FOR TASK NO. C-09
RVTC
TASK:

Identify Starting System Components and Describe Operation

ANSWER KEY
PAGE 1 OF 1
Multiple Choice questions

<u>a</u> 1.	<u>b</u> 6.	___ 11.	___ 16.	___ 21.
<u>a</u> 2.	<u>b</u> 7.	___ 12.	___ 17.	___ 22.
<u>c</u> 3.	<u>d</u> 8.	___ 13.	___ 18.	___ 23.
<u>d</u> 4.	___ 9.	___ 14.	___ 19.	___ 24.
<u>c</u> 5.	___ 10.	___ 15.	___ 20.	___ 25.

True-False questions

T ☐ 1.	T F 6.	T F 11.	T F 16.	T F 21.
T ☐ 2.	T F 7.	T F 12.	T F 17.	T F 22.
☐ T F 3.	T F 8.	T F 13.	T F 18.	T F 23.
☐ T F 4.	T F 9.	T F 14.	T F 19.	T F 24.
T F 5.	T F 10.	T F 15.	T F 20.	T F 25.

Matching questions

<u>h</u> 1.	<u>j</u> 6.	<u>f</u> 11.	___ 16.	___ 21.
<u>b</u> 2.	<u>e</u> 7.	<u>i</u> 12.	___ 17.	___ 22.
<u>m</u> 3.	<u>c</u> 8.	<u>d</u> 13.	___ 18.	___ 23.
<u>l</u> 4.	<u>g</u> 9.	___ 14.	___ 19.	___ 24.
<u>a</u> 5.	<u>k</u> 10.	___ 15.	___ 20.	___ 25.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	09

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7700 State Road 544 N
Winter Haven, Florida 33880

IN-9043-C-08

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Repair Charging System Components

DUTY:

Troubleshooting and Repairing Electrical System

PURPOSE :

The charging system puts current back into the battery after the engine starts. When the charging system fails or does not function properly the battery is either drained or damaged resulting in component replacement or repair.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	C	08	C-07

REVISED

STUDENT PERFORMANCE OBJECTIVES:

2
RVTC

TERMINAL PERFORMANCE OBJECTIVE:

GIVEN: test components and access to the tool room and test equipment,

YOU WILL: repair a charging system component.

HOW WELL: Your performance will be assessed by your instructor using the Performance Test on page 12.

NOTE:

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Repair D.C. generator.
2. Repair A.C. generator or alternator.
3. Repair or adjust voltage regulator.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	08

ENABLING OBJECTIVE NO. 1
RVTC

Repair D.C. generator.

LEARNING STEPS

1. Read Resource No. 1 to identify the procedure for repairing the D.C. generator.
2. Practice repairing a D.C. generator using Resource No.-2.
3. Evaluate your work by completing the Self-Check.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. Instruction Sheet enclosed, Repairing D.C. Generator
2. D.C. generator
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	08	1

INSTRUCTION SHEET

RVTC

Repairing D.C. GeneratorPAGE 1 OF 1

1. Follow the suggested manufacturer's procedures in the repair manual for disassembling a D.C. generator for make, model and year of the component.
2. While disassembling the component study its construction and part relationships.
3. Disassemble all parts except the field coil and pole shoe assembly.
4. Wash all parts except the brushes, armature and field coils in the recommended solvent.
5. Inspect all parts for wear, mechanical damage, or burning.
6. Discard all damaged or worn parts.

NOTE: The commutator can be turned and reused if it is not seriously damaged or the armature is faulty.

Replace drive end bearing, bushing and brushes

1. After cleaning, inspect the drive end bearing for chips and excessive wear.
2. If satisfactory, pack with high melting point ball bearing grease.
3. Check specifications for special bearing oiler and follow oiling procedures.
4. Inspect the commutator end plate bushing. Replace the bushing or the entire end plate.
5. Always install new brushes when repairing a generator.
6. Check assembly procedure in the repair manual for instruction to attach brushes to its holders.

CAUTION: Brush tension may be a factor, so check specifications. Brush setting is also essential.

Reassembling the D.C. Generator

1. Assemble in the reverse order of disassembly, following the repair manual reassembly procedure.
2. After operational checks have been made have your instructor inspect your work.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	08	1

SELF-CHECK

RVTC

Directions

Evaluate your work by answering the items below.

All items should receive a "YES" response.

- | | <u>YES</u> | <u>NO</u> |
|---|------------|-----------|
| 1. Was the repair manual used for the make, model and year of the generator?..... | _____ | _____ |
| 2. Was the battery tested?..... | _____ | _____ |
| 3. Were all parts except the field coil and pole shoe assembly disassembled?..... | _____ | _____ |
| 4. Were correct parts washed in solvent?..... | _____ | _____ |
| 5. Were worn parts inspected and discarded?..... | _____ | _____ |
| 6. Was commutator inspected?..... | _____ | _____ |
| 7. Were end bearings, bushing and brushes lubed or replaced?..... | _____ | _____ |
| 8. Was unit reassembled according to specifications?..... | _____ | _____ |
| 9. Was unit checked for smooth operation?..... | _____ | _____ |
| 10. Was unit checked by your instructor?..... | _____ | _____ |

If you received a "NO" response for any item, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	08	1

ENABLING OBJECTIVE NO. 2
RVTC

Repair A.C. generator or alternator.

LEARNING STEPS

1. Read Resource No. 1 to identify the procedure for repairing an A.C. generator or alternator.
2. Using Resource No. 2 practice repairing the A.C. generator or alternator.
3. Evaluate your work by completing the Self-Check.
4. Go on to Enabling Objective No. 3.

RESOURCES

1. Instruction Sheet enclosed, Repairing A.C. Generator
2. A.C. generator
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	08	2

INSTRUCTION SHEET

RVTC

PAGE 1 OF 1Repairing A.C. Generator

1. Obtain and follow the suggested manufacturer's procedures for the disassembly of an A.C. generator (alternator).
2. While disassembling the components, study their construction and part relationships.
3. Clean all parts except the rotor, startor, slip ring and brushes in solvent.
4. Where applicable, clean and inspect bearings. If reusable repack with bearing grease.
5. Discard defective diodes, brushes, brush springs, capacitor and slip rings.

NOTE: These components should have been tested previously.

Assembling an A.C. Generator

1. Replace worn components with new ones in the reverse order in which they were disassembled. The proper repair manual will list this procedure.
2. Make sure all parts are correctly located.
3. Spin the rotor to check for free operation.

CAUTION: Do Not attempt to polarize an alternator - serious damage can be done.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	08	1

SELF-CHECK

RVTC

Directions

Evaluate your work by answering the items below.

All items should receive a "YES" response.

	<u>YES</u>	<u>NO</u>
1. Was repair manual used for the make, model and year of the alternator?.....	_____	_____
2. Were parts laid out properly for simple identification and inspection?.....	_____	_____
3. Were parts cleaned in the proper solutions?.....	_____	_____
4. Were all alternator components inspected and serviced properly?.....	_____	_____
5. Were worn parts replaced with new ones?.....	_____	_____
6. Was alternator reassembled?.....	_____	_____
7. Was rotor spun to check for proper operation of the alternator?.....	_____	_____
8. Was unit checked by your instructor?.....	_____	_____

If you received a "NO" response for any item, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	08	2

ENABLING OBJECTIVE NO. 3
RVTC

Repair or adjust voltage regulator.

LEARNING STEPS

1. Read and view Resource No. 1 to identify the procedure for repairing or adjusting a voltage regulator.
2. Using Resource No. 2, practice repairing and adjusting a voltage regulator.
3. Evaluate your work by completing the Self-Check.
4. When you think you can perform this task, take the Performance Test.

RESOURCES

1. a. Instruction Sheet enclosed, Repair or Adjust Voltage Regulator
b. Hoffman slide/tape units: 5.2.A, 5.3.A and 5.4.A.
2. a. D.C. generator regulator
b. A.C. generator regulator
3. Self-Check enclosed.
4. Performance Test for task_C-08.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
JY	9043	C	08	3

INSTRUCTION SHEET

RVTC

PAGE 1 OF 1Repair or Adjust Voltage RegulatorAdjusting D.C. Generator Regulator

1. There are several types of regulators with different features and methods of adjustment. Before making any adjustments be sure that you have accurately identified the regulator according to make, model and year.

Adjusting A.C. Generator Regulator

1. Some A.C. generators and regulators cannot be adjusted. Others can be and yet another type is transistorized and is adjusted through an access plug on the top of the regulator.

CAUTION: Extreme care should be taken to identify what type of regulator you are working with. The repair manual will give you detailed instructions on how to adjust or whether the regulator can be adjusted.

Replace or Repair the A.C. and D.C. Generator Regulator

1. If tests indicate that the regulator is malfunctioning and all the approved adjustment steps have been followed, the only other repair procedure would be to replace the regulator with one that is compatible to the type of generator used.

NOTE: It must have the same polarity and be mounted in the recommended position. The wires and connection should be tight and clean.

2. Have your instructor check your adjustments before the unit is secured or discarded.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	08	3

SELF-CHECK

RVTC

Directions

Evaluate your work by answering the items below.

All items should receive a "YES" response.

- | | <u>YES</u> | <u>NO</u> |
|--|------------|-----------|
| 1. Was repair manual used for the make, model and year of the regulator used?..... | _____ | _____ |
| 2. Was specific type of regulator determined?..... | _____ | _____ |
| 3. Was regulator adjustable?..... | _____ | _____ |
| 4. Was regulator inspected for signs of possible problems?_____ | _____ | _____ |
| 5. Was regulator previously tested?..... | _____ | _____ |
| 6. Were proper tools used to adjust or dismantle the unit?_____ | _____ | _____ |
| 7. Was unit cleaned and secured properly?..... | _____ | _____ |
| 8. Was unit inspected by your instructor?..... | _____ | _____ |

If you received a "NO" response for any item, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	08	3

PERFORMANCE TEST FOR TASK NO. C-08

RVTC

IN-9043-C-08

TASK:

Repair Charging System Components

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will repair charging system components. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Was correct repair manual used?		
2.	Was battery tested?		
3.	Was D.C. generator disassembled properly?		
4.	Were correct parts washed in solvent?		
5.	Were parts inspected and serviced?		
6.	Were unserviceable parts replaced?		
7.	Was unit reassembled properly (D.C. generator)?		
8.	Was unit checked for smooth operation?		
9.	Was (A.C. generator) identified as to make, model and year?		
10.	Were proper parts cleaned in the proper solution (A.C. generator)?		
11.	Were all alternator components inspected and serviced properly?		
12.	Was alternator reassembled properly?		
13.	Were worn parts replaced with new ones?		
14.	Was unit operational after repairs?		
15.	Was specific type of regulator determined?		
16.	Were correct tools used to adjust or replace the unit?		
17.	Was unit tested for proper operation?		
18.	Were safety procedures followed?		
Score _____ ☐ NOT ATTAINED		EVALUATOR'S SIGNATURE _____	
DEPT.	PROG.	DUTY	TASK
IN	9043	C	08
Page 1 of 1			

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7700 State Road 544 N
Winter Haven, Florida 33880

IN-9043-C-07

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Test Charging System With a Volt Amp Tester

DUTY:

Troubleshooting and Repairing Electrical System

PURPOSE :

The charging system puts current back into the battery after the engine starts. Without a charging system, the battery would be drained of energy and the vehicle would stop running. The charging system also provides current for the electrical system. Since the charging system affects all the electrical components, you must know how to test the system using a volt amp tester.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	C	07	C-02

REVISED				
6/80				

This student learning guide is used in the Automotive Mechanics Program at Ridge Vocational-Technical Center. The guide was prepared by Michael Taylor and Reginald Flowers, Program Instructors, and the Demonstration Site Staff.

For further information about the project at Ridge --
A Demonstration Site for Competency-Based Vocational Education,
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Winter Haven, Florida 33880
Phone: (813) 422-6402

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:****GIVEN:** a test vehicle and a volt amp tester,**YOU WILL:** test the charging system with a volt amp tester.**HOW WELL:** You must successfully complete the Written Test.
Your performance will be assessed by your instructor using the Performance Test on page 18.**NOTE:**IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL
INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE,
SEE YOUR INSTRUCTOR.**ENABLING OBJECTIVES:**

1. Identify the process of testing the charging system.
2. Determine the procedure for connecting the volt amp tester to the charging system.
3. Test a system output.
4. Test the alternator output.
5. Test the voltage regulator circuit.
6. Test the system circuit resistance, insulated circuit resistance and ground circuit resistance.
7. Test the charging system with a volt amp tester.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	07

ENABLING OBJECTIVE NO. 1
RVTC

Identify the process of testing the charging system.

LEARNING STEPS

1. Read Resource No. 1 describing the test, wiring diagrams, tools and safety practices.
2. View Resource No. 2 identifying the steps in the completion of the charging system test.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 2.

RESOURCES

1. Text: Engine Tune-Up Service, Unit 2, pages 27 - 35.
2. Hoffman slide/tape units: 5.1.C., 5.3.A., 5.4.A. and 5.8.C .
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	07	1

SELF-CHECK**RVTC**Directions

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. The charging system output test can be made if the vehicle battery has failed.
2. The diode rectifiers or diodes change the current from AC to DC.
3. The field relay test measures voltage and amps from the battery to the alternator.
4. The voltage regulator test is made before the alternator test.
5. The first test that is made on the charging system is the system output test.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	07	1

SELF-CHECK**RVTC**Answer Key

1. F
2. T
3. T
4. F
5. T

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	07	1

532

ENABLING OBJECTIVE NO. 2

RVTC

~~Describe the procedure for connecting the volt amp tester to the~~
~~device.~~

LEARNING STEPS

~~Read Instruction No. 1 to identify~~
~~the procedure for hooking~~
~~up the tester.~~

~~Apply your knowledge by~~
~~completing the Self-Check.~~

~~Read the instruction before~~
~~attempting to enable~~
~~Instruction No. 1.~~

RESOURCES

1. a. Instruction Book: Snap-on
MT552B, Starting and
Charging Circuit Tester,
pages 1 - 13.
 - b. Instruction Manual: Sun
Volt Ampere Tester, Model
Vat-40, pages 1 - 18.
2. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
EN	9043	C	07	2

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by writing the letter of the description in Column B that best identifies each illustration in Column A, on a separate sheet of paper.

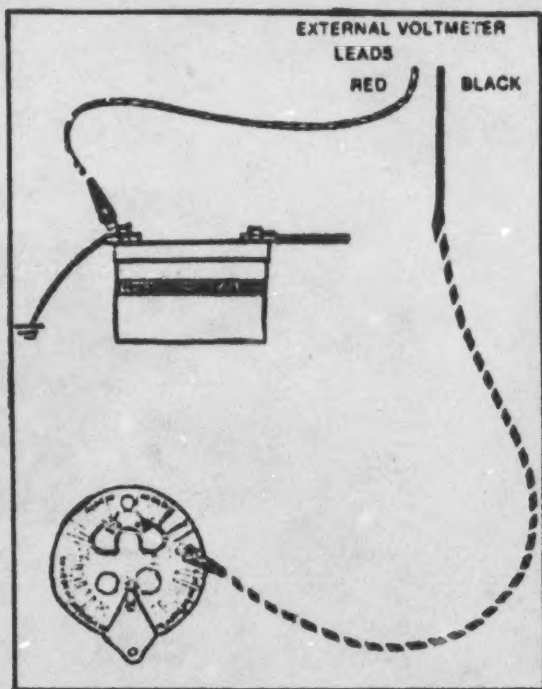
Column A

Figure 1

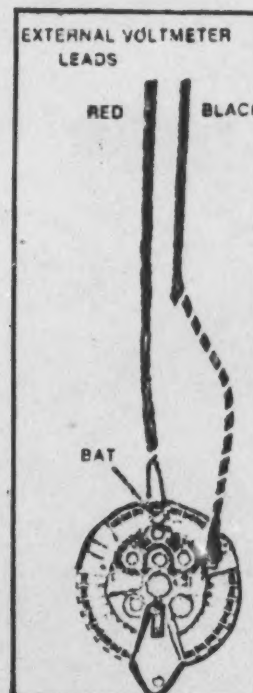


Figure 2

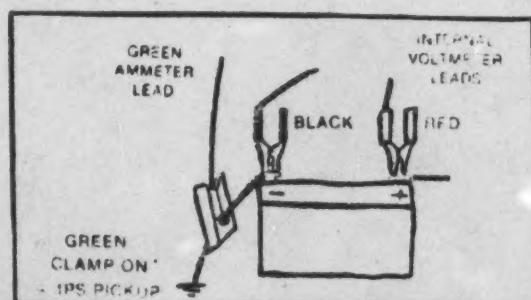


Figure 3

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	07	2

SELF-CHECK

RVTC

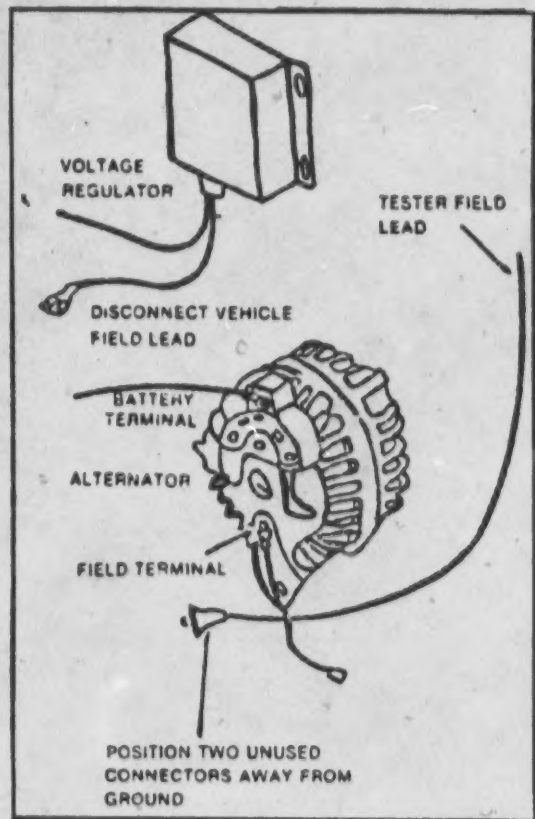


Figure 4

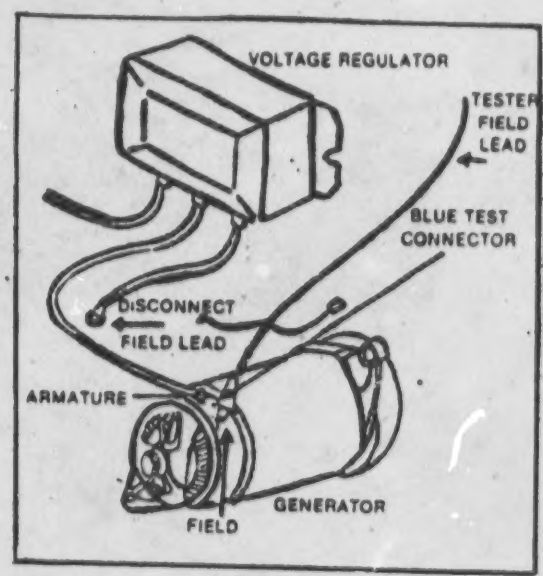


Figure 5

Column B

- a. charging system output
- b. alternator output
- c. generator output
- d. charging circuit resistance
- e. ground circuit resistance test

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	07	2

SELF-CHECK

RVTC

Answer Key

1. c
2. d
3. e
4. b
5. a

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	07	2

ENABLING OBJECTIVE NO. 3

RVTC

Test a system output.

LEARNING STEPS

1. Read Resource No. 1 to identify the steps in performing the system output.
2. Using Resource No. 2, hook-up the volt amp tester.

CAUTION: DO NOT START THE ENGINE UNTIL THE WIRING HOOK-UP IS CHECKED BY THE INSTRUCTOR.
3. Follow the steps in Resource No. 3 while testing the system. Compare the results with the manufacturer's specifications.
4. See your instructor before continuing to Enabling Objective No. 4.

RESOURCES

1. Text: Engine Tune-Up Service, Unit 2, pages 35 - 39.
2.
 - a. Shop engine -- 350 CID
 - b. Instruction Book: Snap-on MT552B, Starting and Charging Circuit Tester, page 7.
 - c. Instruction Manual: Sun Volt Ampere Tester, Model Vat-40, page 5.
3. Text: Engine Tune-Up Service, Unit 2, page 35.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	07	3

ENABLING OBJECTIVE NO. 4
RVTC

Test the alternator output.

LEARNING STEPS

1. Read Resource No. 1 to identify the steps in performing the alternator output.
2. Follow the steps in Resource No. 2 to hook-up the tester.
3. Follow the steps in Resource No. 3 to complete the test. Compare the results with the manufacturer's specifications.
4. See your instructor before continuing to Enabling Objective No. 5.

RESOURCES

1. Text: Engine Tune-Up Service, Unit 2, pages 39 - 42.
2. a. Instruction Book: Snap-on MT552B, Starting and Charging Circuit Tester, page 8.
3. Text: Engine Tune-Up Service, Unit 2, pages 40 - 42.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	07	4

ENABLING OBJECTIVE NO. 5

RVTC

Test the voltage regulator circuit.

LEARNING STEPS

1. Read Resource No. 1 to identify the steps in performing the voltage regulator test.
2. Follow the steps in Resource No. 2 to hook-up the regulator test.

CAUTION: DO NOT START THE ENGINE UNTIL THE HOOK-UP IS CHECKED BY THE INSTRUCTOR.

3. Follow the steps in Resource No. 3 to complete the test. Compare the results with the Manufacturer's specifications.
4. See your instructor before continuing to Enabling Objective No. 6.

RESOURCES

1. Text: Engine Tune-Up Service, Unit 2, pages 42 - 44.
2. a. Instruction Book: Snap-on MT552B, Starting and Charging Circuit Tester, page 7.
b. Instruction Manual: Sun Volt Ampere Tester, Model Vat-40, pages 15 - 17.
3. Text: Engine Tune-Up Service, Unit 2, page 44 (steps 1 - 5).

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	07	5

ENABLING OBJECTIVE NO. 6

RVTC

Test the system circuit resistance, insulated circuit resistance and ground circuit resistance.

LEARNING STEPS

1. Read Resource No. 1 to identify the steps in performing the circuit resistance test.
2. Follow the steps in Resource No. 2 to hook-up the resistance tester.

CAUTION: DO NOT START THE ENGINE UNTIL THE HOOK-UP IS CHECKED BY THE INSTRUCTOR.

3. Follow the steps in Resource No. 3 to complete the test. Compare the results with the manufacturer's specifications.
4. See your instructor before going on to the next step.
5. When you think you can attain this task, take the Written Test.
6. Go on to Enabling Objective No. 7.

RESOURCES

1. Text: Engine Tune-Up Service, Unit 2, page 45.
2. a. Instruction Book: Snap-on MT552B, Starting and Charging Circuit Tester, page 11.
b. Instruction Manual: Sun Volt Ampere Tester, Model Vat-40, page 16.
3. Text: Engine Tune-Up Service, Unit 2, page 45.
4. Instructor
5. Written Test for task C-07.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	07	6

WRITTEN TEST FOR TASK NO. C-07

RVTC

IN-9043-C-07

TASK:

Test Charging System With a Volt Amp Tester

PAGE 1 OF 2Directions

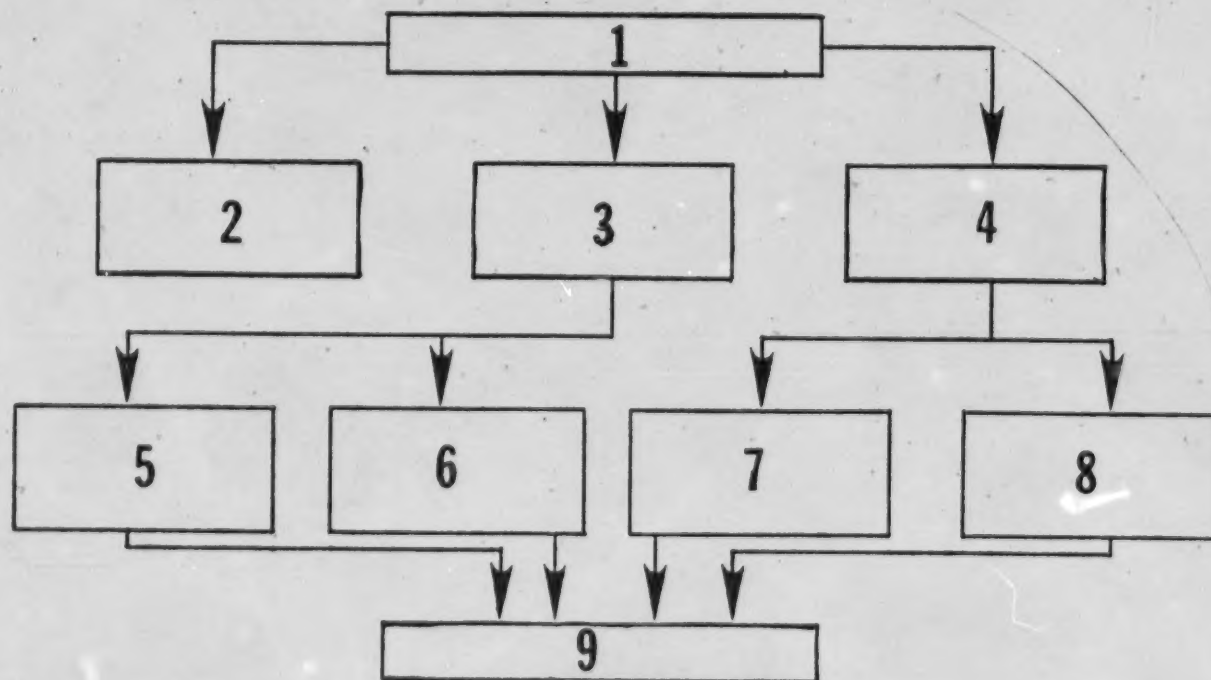
The purpose of this test is to determine if you fully understand how to test the charging system with a volt amp tester. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Matching. On the separate Answer Sheet, write the letter of the description in Column B that best identifies each box in Column A.

DO NOT WRITE ON THIS TEST!

Matching questionsColumn A

Charging System Test Sequence



DEPT.	PROG.	DUTY	TASK
IN	9043	C	07

WRITTEN TEST FOR TASK NO. C-07

RVTC

IN-9043-C-07

TASK:

Test Charging System With a Volt Amp Tester

Column BPAGE 2 OF 2

- a. The voltage regulator is bad; replace, or adjust if possible.
- b. Retest the charging system.
- c. Ten percent below rated output; perform the alternator output test.
- d. The alternator is okay; replace the regulator.
- e. Conduct the charging system output test.
- f. Meets rated output; the charging system is okay.
- g. Ten percent above rated output; perform the voltage regulator test.
- h. The voltage regulator is okay; perform the circuit resistance test.
- i. The alternator output is 10 percent below the rated output; repair or replace.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	07

WRITTEN TEST FOR TASK NO. C-07
RVTC
TASK:

Test the Charging System With a Volt Amp Tester

 PAGE 1 OF 1
Answer Key

1. e
2. f
3. c or g
4. c or g
5. h, a, d or e
6. h, a, d or e
7. h, a, d or e
8. h, a, d or e
9. b

DEPT.	PROG.	DUTY	TASK
IN	9043	C	07

ENABLING OBJECTIVE NO. 7
RVTC

Test the charging system with a volt amp tester.

LEARNING STEPS

1. Using Resource No. 1 practice testing the charging system with a volt amp tester. If necessary review Resource No. 1d.
2. When you think you can perform this task, take the Performance Test.

RESOURCES

1.
 - a. Test vehicle
 - b. Volt amp tester
 - c. Instruction book for
 - d. Hoffman slide/tape units: 5.1.C., 5.3.A., 5.4.A. and 5.8.C.
2. Performance Test for task C-07.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	07	7

PERFORMANCE TEST FOR TASK NO. C-07

RVTC

TASK:

Test the Charging System With a Volt Amp Tester

IN-9043-C-07

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will perform the following tests on a test vehicle. 1) Visual 2) System Output 3) Regulator Test 4) Alternator Test 5) Circuit Resistance. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Was a visual inspection made?.....		
2.	Was the charging system output test completed?.....		
3.	Were the results of the charging system output test compared with the manufacturer's specifications?.....		
4.	Was the voltage regulator test completed?.....		
5.	Were the results of the voltage regulator test compared with the manufacturer's specifications?.....		
6.	Was the alternator output test completed?		
7.	Were the results of the alternator output test compared to the manufacturer's specifications?.....		
8.	Was the circuit resistance test completed according to manufacturer's specifications?.....		

☐ ATTAINED
☐ NOT ATTAINED

Score _____ EVALUATOR'S SIGNATURE _____

DEPT.	PROG.	DUTY	TASK	ATTEMPT
IN	9043	C	07	

Page 1 of 1

RVTC

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Engine Tune-Up Service, State of Florida, Department of Education
Division of Vocational Education, Tallahassee, Florida.

Snap-on MT552B Starting and Charging Circuit Tester, Snap-on Tools
Corporation, Wisconsin.

Sun Volt Ampere Tester, Model Vat-40, Sun Electric Corporation,
Illinois.

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IN-9043-C-06

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Identify Charging System Components

DUTY:

Troubleshooting and Repairing Electrical System

PURPOSE :

A working knowledge of the operation, design and appearance of the charging system is essential in diagnosing and repairing that system in today's automotive world.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	C	06	

REVISED :

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:****GIVEN:****YOU WILL:** identify charging system components.**HOW WELL:** You must successfully complete the Written Test.**NOTE:**

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Identify DC charging system components.
2. Identify AC charging system components.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	6

ENABLING OBJECTIVE NO. 1

RVTC

Identify DC charging system components.

LEARNING STEPS

1. Read Resource No. 1 to identify DC charging system components.
2. Evaluate your knowledge by completing the Self-Check.
3. Go on to Enabling Objective No. 2.

RESOURCES

1. a. Text: Automotive Encyclopedia, pages 345 - 350, 363 - 368.
- b. Hoffman slide/tape units: 5.1.A, 5.6.A, 5.3.A, 5.8.E
2. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	06	1

SELF-CHECK

4
RVTC

Directions

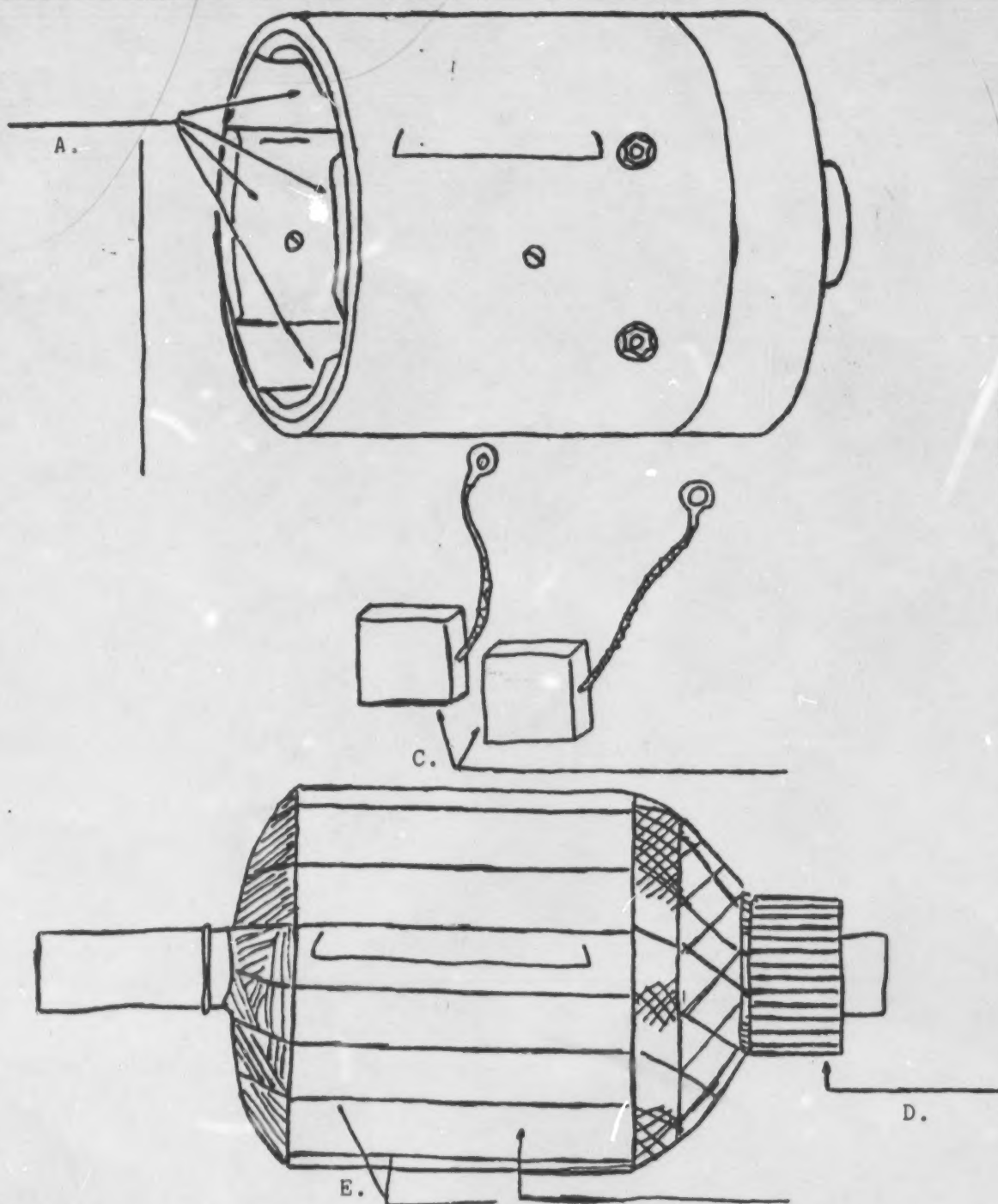
Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. Electromagnetic coils
2. Armature windings
3. Brushes
4. Commulator
5. Laminations
6. Current regulator
7. Voltage regulator
8. Cutout relay

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	06	1

SELF-CHECK

RVTC



Now check your answers with the Answer Key^{B.}

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	6	1

SELF-CHECK

6
RVTC

Answer Key

1. a
2. b
3. c
4. d
5. e

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	06	1

7
ENABLING OBJECTIVE NO. 2

RVTC

Identify AC charging system components.

LEARNING STEPS

1. Read Resource No. 1 to identify the AC charging system component.
2. Evaluate your knowledge by completing the Self-Check.
3. When you think you can attain this task, take the Written Test.

RESOURCES

1. Text: Automotive Encyclopedia, pages 345 - 350, 369 - 379.
2. Self-Check enclosed.
3. Written Test for task C-06.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	06	2

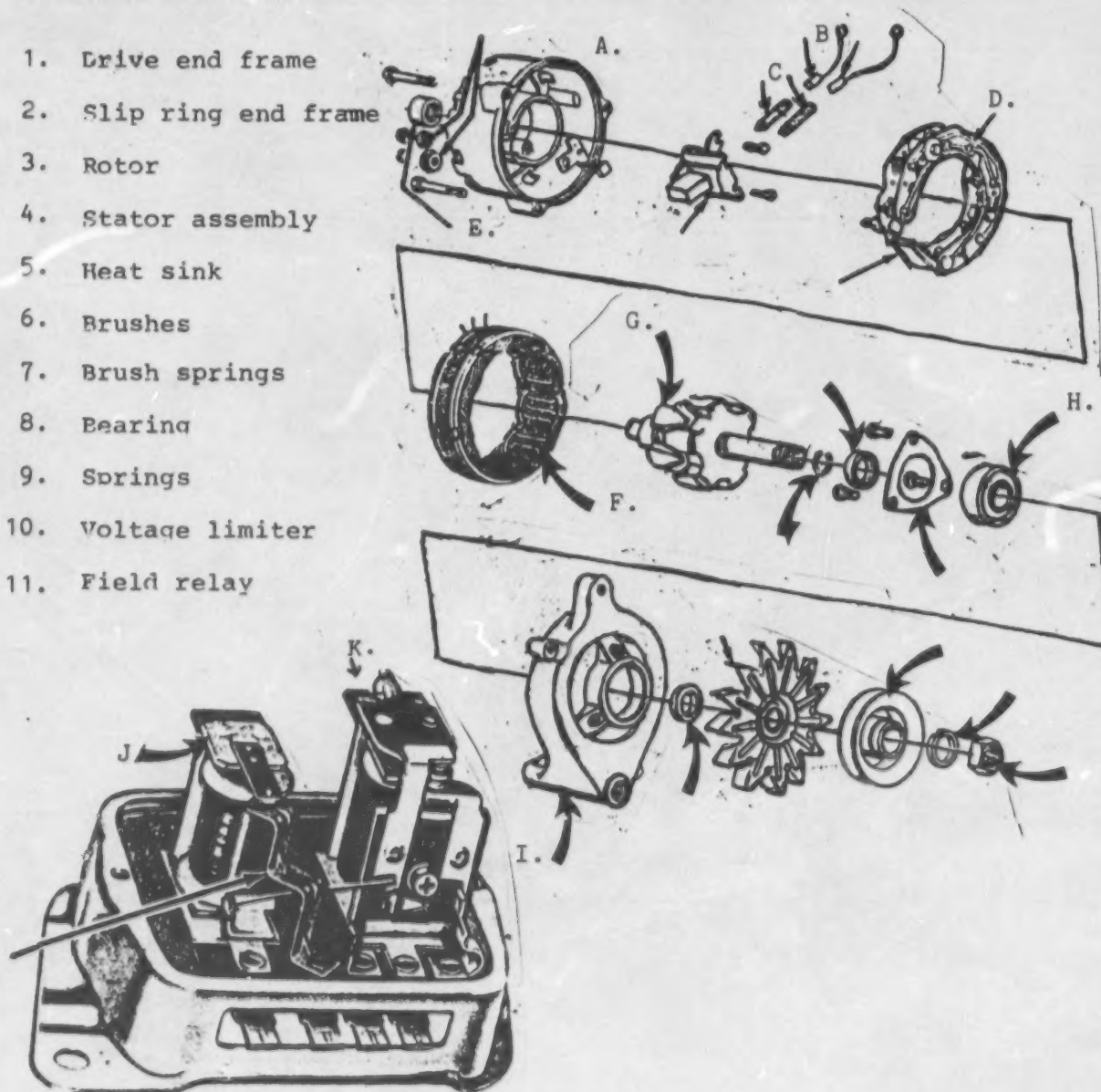
SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. Drive end frame
2. Slip ring end frame
3. Rotor
4. Stator assembly
5. Heat sink
6. Brushes
7. Brush springs
8. Bearing
9. Springs
10. Voltage limiter
11. Field relay



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	06	2

SELF-CHECK

RVTC

Answer Key

1. i
2. a
3. g
4. f
5. d
6. b
7. c
8. h
9. e
10. j
11. k

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	06	2

WRITTEN TEST FOR TASK NO. C-06

RVTC

IN-9043-C-06

TASK:

Identify Charging System Components

DirectionsPAGE 1 OF 2

The purpose of this test is to determine if you fully understand how to identify charging system components. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Multiple Choice. On a separate Answer Sheet, put the letter of the correct answer in the blank to the left of the number of the question.

DO NOT MARK ON THIS TEST!

Multiple Choice questions

1. When a problem exists in the electrical system you should first check the:
 - a. battery.
 - b. fuses.
 - c. wiring.
 - d. regulator.
2. Most modern vehicles are equipped with:
 - a. a generator.
 - b. rectifier.
 - c. alternator.
 - d. ballast resistor.
3. The alternator produces _____ current.
 - a. DC
 - b. AC
 - c. 110 volt
 - d. 220 volt
4. The regulator's function is to control the _____ in the charging system.

a. current produced	c. resistance
b. capacitance	d. current used

DEPT.	PROG.	DUTY	TASK
IN	9043	C	06

WRITTEN TEST FOR TASK NO. C-06

RVTC

IN-9043-C-06

TASK:

Identify Charging System Components

PAGE 2 OF 2

5. For a charging system output test, the recommended limit for the alternator output voltage is:
- 14 volts.
 - 16 volts.
 - 18 volts.
 - 24 volts.
6. Which of the following is not a component of the charging system?
- battery
 - alternator
 - regulator
 - startor
7. In a direct current generator, voltage is generated in which unit?
- armature
 - field
 - startor
 - regulator
8. In most alternators, the voltage is generated in which part of the unit?
- rotor
 - startor
 - commulator
 - rectifier
9. When the battery is low in charge, what does the regulator do?
- cuts resistance out of the generator field circuit.
 - cuts resistance into the generator field circuit.
 - cuts resistance into the armature circuit.
 - cuts resistance into the startor.
10. What is the purpose fo the voltage regulator?
- maintain a constant charging rate
 - prevent the circuit voltage from exceeding a predetermined value
 - prevent battery from discharging through the generator
 - prevent the circuit from shorting

DEPT.	PROG.	DUTY	TASK
IN	9043	C	06

WRITTEN TEST FOR TASK NO. C-06
RVTC
TASK:

Identify Charging System Components

ANSWER KEY
PAGE 1 OF 1
Multiple Choice questions

- | | | | | |
|-------------|--------------|---------|---------|---------|
| <u>a</u> 1. | <u>d</u> 6. | ___ 11. | ___ 16. | ___ 21. |
| <u>c</u> 2. | <u>b</u> 7. | ___ 12. | ___ 17. | ___ 22. |
| <u>b</u> 3. | <u>a</u> 8. | ___ 13. | ___ 18. | ___ 23. |
| <u>a</u> 4. | <u>a</u> 9. | ___ 14. | ___ 19. | ___ 24. |
| <u>a</u> 5. | <u>b</u> 10. | ___ 15. | ___ 20. | ___ 25. |

True-False questions

- | | | | | |
|--------|---------|---------|---------|---------|
| T F 1. | T F 6. | T F 11. | T F 16. | T F 21. |
| T F 2. | T F 7. | T F 12. | T F 17. | T F 22. |
| T F 3. | T F 8. | T F 13. | T F 18. | T F 23. |
| T F 4. | T F 9. | T F 14. | T F 19. | T F 24. |
| T F 5. | T F 10. | T F 15. | T F 20. | T F 25. |

Matching questions

- | | | | | |
|--------|---------|---------|---------|---------|
| ___ 1. | ___ 6. | ___ 11. | ___ 16. | ___ 21. |
| ___ 2. | ___ 7. | ___ 12. | ___ 17. | ___ 22. |
| ___ 3. | ___ 8. | ___ 13. | ___ 18. | ___ 23. |
| ___ 4. | ___ 9. | ___ 14. | ___ 19. | ___ 24. |
| ___ 5. | ___ 10. | ___ 15. | ___ 20. | ___ 25. |

DEPT.	PROG.	DUTY	TASK
IN	9043	C	06

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IN-9043-C-05

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Diagnose and Repair Ignition System Problems

DUTY:

Troubleshooting and Repairing Electrical System

PURPOSE :

When a gasoline engine fails to start it is usually out of fuel, out of time or not getting the proper voltage. Problems concerning the ignition system are not always easy to diagnose. This guide will help you identify some procedures for troubleshooting, testing and repairing problems in the ignition system.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	C	05	

REVISED				

STUDENT PERFORMANCE OBJECTIVES:

RVTC

TERMINAL PERFORMANCE OBJECTIVE:

GIVEN: test vehicle, access to the tool room and test equipment,

YOU WILL: diagnose and repair an ignition system problem.

HOW WELL: You must successfully complete the Written Test.
Your performance will be assessed by your instructor using the Performance Test on page 25.

NOTE:

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Analyze problems in the ignition system.
2. Repair the ignition system.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	05

ENABLING OBJECTIVE NO. 1
RVTC

Analyze problems in the ignition system.

LEARNING STEPS

1. View Resource No. 1 to identify the procedure for analyzing the ignition system.
2. Evaluate your knowledge by completing the Self-Check.
3. Read Resource No. 3 to describe the procedure for repairing the ignition system.
4. When you think you can attain this task, take the Written Test.
5. Go on to Enabling Objective No. 2.

RESOURCES

1. a. Hoffman slide/tape units: 6.1.A, 6.1.B and 6.1.C.
b. Bergwall Filmstrip/tape: #401, parts 3, 4, 5 and 6.
2. Self-Check enclosed.
3. Text: Chilton's Motor or Mitchell's Auto Repair Manual, "Repairing Ignition System Components" for make, model and year of vehicle.
4. Written Test for task C-05

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	05	1

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. When a gasoline automobile engine fails to start, what are the possible causes?
 - a. out of fuel
 - b. not getting proper voltage
 - c. out of time
 - d. all of the above
2. If the engine is flooded, hold the gas pedal to the floor and start the engine in short bursts of _____ second intervals.
 - a. 15
 - b. 20
 - c. 25
 - d. 30
3. If when making the coil high tension cable test, there is still no spark, then the problem is likely to be in the:
 - a. ignition secondary circuit.
 - b. starting circuit.
 - c. ignition primary circuit.
 - d. ignition switch.
4. When testing the distributor cable with an ohmmeter, if the meter shows extremely high resistance it indicates that the cable is:
 - a. too long.
 - b. too short.
 - c. broken.
 - d. alright.
5. If the coil center tower appears to have grey-green matter on it, this indicates excessive:
 - a. voltage.
 - b. amperage.
 - c. resistance.
 - d. power.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	05	1

SELF-CHECK

RVTC

6. If there is not any voltage through the ignition switch, a systematic check backwards through the circuitry toward the _____ is needed.
 - a. battery
 - b. coil
 - c. relay
 - d. distributor
7. A problem in the distributor cap could mean a cracked or broken distributor cap, _____ of the distributor cap center tower or center contact is not in the cap.
 - a. arcing
 - b. burning
 - c. splitting
 - d. corrosion

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. An oscilloscope saves a lot of guesswork in troubleshooting the ignition system.
2. Little or no drop in r.p.m.'s on the tachometer when checking spark jump indicates that the cylinder is firing.
3. An increase in r.p.m. when a cable is removed indicates crossed spark plug cables.
4. When testing the cables with an ohmmeter, any reading over 1000 ohms indicates a cable with too much resistance.
5. Loose distributor bushings are indicated by multiple arrows appearing on the protractor scale.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	05	1

SELF-CHECK

RVTC

Answer Key

Multiple Choice questions

1. d
2. a
3. c
4. c
5. c
6. a
7. d

True-False questions

1. T
2. F
3. T
4. F
5. T

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	05	1

WRITTEN TEST FOR TASK NO. C-05

RVTC

TASK:

Diagnose and Repair an Ignition System Problem

Directions

PAGE 1 OF 11

IN-9043-C-05

The purpose of this test is to determine if you fully understand how to diagnose and repair an ignition system problem. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Multiple Choice. On the separate Answer Sheet, put the letter of the correct answer in the blank to the left of the number of the question.

DO NOT MARK ON THIS TEST!

Multiple Choice questions

1. Which of the following problems could be caused by the ignition system?
 - a. engine cranks, but does not start
 - b. engine misses at high speed
 - c. engine is cross-firing to wrong cylinder
 - d. all of the above
2. What could be wrong when an engine cranks too slow to start?
 - a. a worn out battery
 - b. battery connections are faulty
 - c. a faulty starter circuit
 - d. all of the above
3. Which of the following is used to make a specific gravity test of a battery?
 - a. hydrometer
 - b. dwell meter
 - c. vacuum gauge
 - d. all of the above
4. A worn out battery should be tested with a:
 - a. hydrometer
 - b. battery load tester
 - c. battery charger
 - d. all of the above

DEPT.	PROG.	DUTY	TASK
IN	9043	C	05

WRITTEN TEST FOR TASK NO. C-05

RVTC

TASK:

Diagnose and Repair an Ignition System Problem

PAGE 2 OF 11

IN-9043-C-05

5. Which of the following is the best way to clean acid corrosion from a battery and battery connections?
 - a. with gasoline and wire brush
 - b. with engine oil and a stiff brush
 - c. with a baking soda solution and a stiff brush
 - d. with a rag and plain water
6. What is the main purpose for sealing a battery terminal after it has been cleaned?
 - a. to prevent future oxidation
 - b. to insure better battery current flow
 - c. to protect cable connections from adverse conditions
 - d. none of the above
7. How does a faulty starter affect the operation of the ignition system?
 - a. it causes a voltage drop in the primary circuit of the ignition system
 - b. it causes an increase of current flow to the ignition system
 - c. it draws less current, doing so, it prolongs the life of spark plugs
 - d. none of the above
8. A faulty starter should be checked with a/an:
 - a. dwell meter.
 - b. voltmeter.
 - c. hydrometer.
 - d. all of the above.
9. What is the allowable voltage drop in a starter circuit?
 - a. .5 volt.
 - b. 1 volt
 - c. 2 volts
 - d. 5 volts
10. In operation, the starter motor should not draw more than:
 - a. 50 amperes.
 - b. 150 amperes.
 - c. 300 amperes.
 - d. 500 amperes.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	05

WRITTEN TEST FOR TASK NO. C-05

RVTC

TASK:

Diagnose and Repair an Ignition System Problem

PAGE 3 OF 11

11. Why is the ignition system connected to the starter solenoid during cranking operation?
 - a. to provide the ignition system with full battery voltage during starting periods
 - b. it is a convenient place to draw current from
 - c. it allows the starter solenoid to remove excess current from the ignition system during cranking periods
 - d. none of the above
12. While troubleshooting an engine problem, a sharp blue spark at the end of a high tension wire to ground indicates a:
 - a. worn set of spark plugs.
 - b. worn set of ignition points.
 - c. weak battery.
 - d. normal spark.
13. A weak, reddish spark at the end of a high tension wire to ground indicates:
 - a. a normal spark.
 - b. excessive voltage in the coil's secondary windings.
 - c. a problem somewhere in the ignition system.
 - d. none of the above.
14. What should be the first step in troubleshooting an engine starting problem?
 - a. make electrical checks of all ignition parts
 - b. make a visual inspection of the starter and the ignition circuits
 - c. install a new set of ignition points
 - d. install a new battery
15. Which of the following are typical ignition system problems?
 - a. an open circuit in the primary circuit
 - b. faulty contact points
 - c. open or shorted high tension wires
 - d. all of the above

DEPT.	PROG.	DUTY	TASK
IN	9043	C	05

WRITTEN TEST FOR TASK NO. C-05

RVTC

TASK:

Diagnose and Repair an Ignition System Problem

PAGE 4 OF 11

16. Where does a mechanic connect the voltmeter on the ignition coil when testing for battery voltage?
- to the negative side
 - to the positive side
 - to the center coil wire
 - to any of the above
17. Circuits within the ignition coil should be checked with a:
- timing light.
 - vacuum gauge.
 - dwell meter.
 - none of the above.
18. Poor continuity across the breaker points is usually caused by:
- a loose wire connection in the distributor cap.
 - a poor ground connection on the battery.
 - contact points that are badly pitted and burned.
 - all of the above.
19. Which of the following instruments is used most effectively to check a wire for resistance?
- a voltmeter
 - an ameter
 - an ohmeter
 - none of the above
20. A shorted-out condenser can be tested with the help of a/an:
- 12 volt test light.
 - dwell meter.
 - timing light.
 - all of the above.
21. How does an open main feed wire from the center tower of the distributor cap affect engine performance?
- it will cause a miss at idle engine speeds
 - it will cause a miss at high engine speeds
 - it will prevent the engine from starting
 - it will cause the engine to stall

DEPT.	PROG.	DUTY	TASK
IN	9043	C	05

WRITTEN TEST FOR TASK NO. C-05

RVTC

TASK:

Diagnose and Repair an Ignition System Problem

PAGE 5 OF 11

22. To prevent a high voltage spark from jumping from the coil tower to ground, the coil must be kept:
 - a. clean.
 - b. dry.
 - c. protected by a seal.
 - d. all of the above.
23. What causes ignition cross-fire?
 - a. worn spark plugs
 - b. worn ignition points
 - c. a defective distributor cap
 - d. all of the above
24. Which of the following is usually at fault when an engine is difficult to start in wet weather?
 - a. a bad condenser
 - b. a faulty set of tension wires
 - c. the ignition timing is late
 - d. the ignition timing is too early
25. The symptom(s) of a set of worn spark plugs are:
 - a. poor gasoline mileage
 - b. poor engine performance
 - c. engine difficult to start
 - d. all of the above
26. Premature spark plug failure is usually caused by:
 - a. using spark plugs of the wrong heat range.
 - b. a worn timing chain.
 - c. a bad set of ignition points.
 - d. none of the above.
27. During spark plug replacement, an oil fouled plug should be replaced:
 - a. with a hotter spark plug.
 - b. with a colder spark plug.
 - c. with one of the same heat range.
 - d. none of the above.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	05

WRITTEN TEST FOR TASK NO. C-05

RVTC

TASK:

Diagnose and Repair an Ignition System Problem

PAGE 6 OF 11

28. During spark plug replacement, a spark plug that shows signs of eroded electrodes should be replaced:
- with a colder spark plug.
 - with a hotter spark plug.
 - with one of the same heat range.
 - none of the above.
29. What determines the heat range of spark plugs?
- the length of the insulator
 - the wrench size used to install them
 - the gap between the two electrodes
 - none of the above
30. When an engine is difficult to start after it warms up, the trouble is usually in:
- the ignition system.
 - the fuel system.
 - the starter circuit.
 - none of the above.
31. Which of the following is a quick and "trade-like" method to check for a defect in an ignition coil?
- replace it with a new one
 - send it out to be examined by an ignition expert
 - disconnect the coil you suspect to be bad and connect a "test-coil"
 - none of the above
32. On what stroke of the engine's cycle does crossfiring flash up through the carburetor?
- the intake stroke
 - the compression stroke
 - the power stroke
 - the exhaust stroke
33. What would happen if two high tension wires were installed in the wrong places?
- the engine will miss on two cylinders
 - crossfire could occur
 - the engine will vibrate during idle speed
 - all of the above

DEPT.	PROG.	DUTY	TASK
IN	9043	C	05

WRITTEN TEST FOR TASK NO. C-05

RVTC

TASK:

Diagnose and Repair an Ignition System Problem

PAGE 7 OF 11

34. One characteristic of electricity is that it:
- always seeks a path of most resistance.
 - always seeks a path of least resistance.
 - never deviates from its original path.
 - none of the above.
35. What is the best way to check a distributor cap you suspect to be defective?
- with a voltmeter
 - with a high frequency test detector
 - with a 12 volt test light
 - none of the above
36. How will a damaged rotor affect the running of an engine?
- it will cause a cross-fire in the engine
 - it will prevent the distributor from turning
 - it will cause a short circuit in the primary circuit of the ignition system
 - all of the above
37. Which of the following occurs in an engine that continues to run with advanced ignition timing?
- damage to the top of the pistons
 - a loss of engine power
 - shattering of the spark plugs
 - all of the above
38. Detonation is caused by:
- running an engine with low oil pressure.
 - a heavy layer of carbon deposits in the combustion chamber.
 - using high octane fuel.
 - none of the above.
39. What causes engine kickback?
- the ignition timing too far advanced in the engine cycle
 - the ignition timing too late in the engine cycle
 - a faulty starter drive
 - none of the above

DEPT.	PROG.	DUTY	TASK
IN	9043	C	05

WRITTEN TEST FOR TASK NO. 05

RVTC

TASK:

Diagnose and Repair an Ignition System Problem

PAGE 8 OF 11

40. "Dieseling" is a trade term to describe which of the following:
- an engine which is running in tip-top shape.
 - an engine which runs on special diesel fuel.
 - an engine which runs on special gasoline
 - none of the above.
41. There are three areas of maintenance required with electronic ignition. They are: the inspection of the distributor cap and rotor, the inspection of the spark plug wires and:
- changing of points and condenser.
 - changing of spark plug wires.
 - cleaning or changing of spark plugs.
 - changing the points.
42. The distributor rotor should be replaced if there are:
- worn bearings.
 - carbon tracks or pitted surfaces.
 - cracked insulators.
 - all of the above.
43. When trouble shooting a no-start condition on a vehicle with electronic ignition, the first step is to remove the coil wire from center of distributor cap and test for:
- battery voltage.
 - spark, when engine is cranked.
 - spark, with engine not turning.
 - none of the above.
44. The coil wire should be held approximately 10 mm from a good grounded metal part using:
- leather gloves.
 - bare fingers.
 - insulated pliers.
 - common pliers.
45. If there is no spark present the trouble is in the:
- fuel system.
 - secondary circuit.
 - primary circuit.
 - charging circuit.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	05

WRITTEN TEST FOR TASK NO. C-05

RVTC

TASK:

Diagnose and Repair an Ignition System Problem

PAGE 9 OF 11

46. To check or set the air gap between the reluctor and the pick-up coil, the reluctor tooth must be aligned with the:
- timing mark in distributor.
 - iron core of pick-up coil.
 - hold-down screw.
 - all of the above.
47. To check the air gap use a:
- pin type feeler gauge.
 - blade type feeler gauge.
 - non-magnetic feeler gauge.
 - none of the above.
48. If the air gap varies between each reluctor tooth and the pick-up coil more than the specified allowance:
- reset the air gap.
 - replace the pick-up coil.
 - replace the distributor.
 - replace the rotor.
49. The five outer terminals on the bottom side of the wiring harness cap are called:
- wiring pins.
 - cavities.
 - terminals.
 - connectors.
50. To test the circuits of cavities 1, 2, and 3, the battery voltage must be measured using a/an:
- ohmmeter.
 - ammeter.
 - voltmeter.
 - full scale.
51. When measuring the voltage during this test, the reading should be:
- zero.
 - 1/2 the battery voltage.
 - within 1 volt of battery voltage.
 - none of the above.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	05

WRITTEN TEST FOR TASK NO. C-05

RVTC

TASK:

Diagnose and Repair an Ignition System Problem

PAGE 10 OF 11

52. The circuit of cavity #1 includes the battery, ammeter, ignition switch and the:
- ballast resistor by-pass.
 - point 5 ohm compensating resistor.
 - ohm auxiliary resistor.
 - ballast resistor.
53. The circuit of cavity #2 includes the battery, ammeter, ignition switch, ignition coil and the:
- ballast resistor by-pass.
 - point 5 ohm compensating resistor.
 - 5 ohm auxiliary resistor.
 - all of the above.
54. The circuit of cavity #3 includes the battery, ammeter, ignition switch and the:
- ballast resistor by-pass.
 - point 5 ohm compensating resistor.
 - 5 ohm auxiliary resistor.
 - capacitor.
55. When using an ohmmeter to make resistance tests in the ignition circuit the ignition switch should be:
- ON.
 - OFF.
 - makes no difference.
 - accessory.
56. An ohmmeter is calibrated on a particular scale range by shorting the test leads together and adjusting the calibrating control until the meter reads:
- zero.
 - half-scale.
 - infinity.
 - 100 ohms.
57. Cavities 4 and 5 are connected to the pick-up coil. This circuit should have a resistance of:
- zero ohms.
 - 300 to 500 ohms.
 - over 500 ohms.
 - 1000 ohms.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	05

WRITTEN TEST FOR TASK NO. C-05

RVTC

TASK:

Diagnose and Repair an Ignition System Problem

IN-9043-C-05

PAGE 11 OF 11

50. If the ohmeter is on the R x 100 range and the pointer indicates 4 on the scale, this is equal to a resistance value of:
- 4 ohms.
 - 100 ohms.
 - 400 ohms.
 - 500 ohms.
59. When using the ohmeter to test if the pick-up coil is grounded, the reading should indicate an open circuit. On the ohmeter scale this is:
- zero.
 - half-scale.
 - infinity.
 - full scale.
60. The 5 ohm and the .5 ohm resistance of the dual ballast resistor can be measured with the ohmeter on the:
- R x 1 scale.
 - R x 10 scale.
 - R x 100 scale.
 - R x 1000 scale.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	05

WRITTEN TEST FOR TASK NO. C-05

RVTC

TASK:

Diagnose and Repair an Ignition System Problem

PAGE 1 OF 1Answer Key

- | | | |
|-------|-------|------------|
| 1. d | 21. c | 41. c |
| 2. d | 22. d | 42. b |
| 3. a | 23. c | 43. b |
| 4. b | 24. b | 44. a |
| 5. c | 25. d | 45. b or c |
| 6. a | 26. a | 46. b |
| 7. a | 27. a | 47. c |
| 8. b | 28. a | 48. c |
| 9. c | 29. a | 49. b |
| 10. c | 30. b | 50. c |
| 11. a | 31. c | 51. c |
| 12. d | 32. a | 52. a |
| 13. c | 33. d | 53. b |
| 14. b | 34. b | 54. c |
| 15. d | 35. b | 55. b |
| 16. b | 36. a | 56. a |
| 17. d | 37. d | 57. b |
| 18. c | 38. b | 58. c |
| 19. c | 39. a | 59. c |
| 20. a | 40. d | 60. a |

DEPT.	PROG.	DUTY	TASK
IN	9043	C	05

ENABLING OBJECTIVE NO. 2

RVTC

Repair the ignition system.

LEARNING STEPS

1. Using Resource No. 1, practice repairing an ignition system.
2. Using Resource No. 2, complete the Self-Check.
3. When you think you think you can perform this task, take the Performance Test.

RESOURCES

1.
 - a. Classroom model of ignition system
 - b. Instruction Sheet enclosed, Procedure Sheet
2.
 - a. Test vehicle
 - b. Self-Check enclosed.
3. Performance Test for task C-05.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	05	2

INSTRUCTION SHEET

RVTC

PAGE 1 OF 4Procedure Sheet

The Engine Won't Start.....

1. Attach a remote starter switch to the engine.
2. Connect a voltmeter across the battery and operate the starter.
3. Remove the air cleaner and move the throttle while looking into the carburetor throat.
4. Check for a clogged filter or defective fuel pump or no fuel in the tank.
5. Remove a spark plug cable, insert metal adapter into the end, and hold the adapter about 1/4" from the engine block and operate the starter.
6. If the engine is flooded, hold the gas pedal to the floor and try to start the engine in short bursts of about 15 second intervals.
7. Remove all the spark plugs and clean or replace them.
8. Crank the engine with a spark plug cable.
9. Remove the high tension cable from the center of the distributor cap.
10. Hold the distributor end of the cable 1/4" from the engine block and operate the engine.
11. Remove the distributor cap and inspect the rotor.
12. Check the distributor cap. Check the ignition primary circuit.
13. Remove the coil to the distributor primary wire.
14. Turn the ignition switch "ON" place the test lamp probe on the coil distributor primary terminal and attach the lead to a good ground.
15. Replace the primary wire on the terminal.
16. Remove the distributor cap and check the contact points.
17. Block the points open.

DEPT.	PROG	DUTY	TASK	EN OBJ.
IN	9043	C	05	2

INSTRUCTION SHEET

RVTC

PAGE 2 OF 4

18. With the ignition on, place the test probe on the contact point leading wire and test lead to a good ground.
19. Remove the condenser lead-in wire and test for voltage.
20. Remove the contact point lead-in wire from the points and attach the light to the end of the wire.
21. Remove the paper blocking the points open and replace the points, if necessary.
22. Remove the coil to the distributor cable and test it with an ohmmeter, replace it if the cable is broken.
23. Inspect the coil center tower for grey-green matter and clean it.
24. Test the coil with the coil tester or oscilloscope.
25. Check for voltage at the ignition switch connector.

The Engine Starts But Misses.....

1. Start engine and let it run at fast idle at operating temperature, then return to idle speed.
2. If engine shakes or runs badly, check to be sure all hoses are connected and there are no intake leaks.
3. Shut off ignition to stop engine.
4. Grasp each spark plug cable boot and push in.
5. Inspect cable end.
6. If rigid or showing signs of cracking -- replace.
7. Grasp each cable at distributor cap and push down.
8. Start engine and recheck operation.
9. If still running badly, connect dwell/tach meter to distributor side of coil primary and check dwell.
10. Adjust dwell if necessary.
11. Adjust idle speed to 1000 R.P.M.

DEPT.	PRG	DUTY	TASK	EN. OBJ.
IN	9043	C	05	2

INSTRUCTION SHEET

RVTC

PAGE 3 OF 4

12. Remove spark plug cables and hold far enough from plug that spark does not jump to plug.
13. Note R.P.M. drop on tach.
14. Continue to remove one cable at a time and note the drop in R.P.M. for each.
15. Check firing order and install cables correctly.
16. Stop engine and remove all spark plugs which showed little or no loss of R.P.M.
17. Inspect plug for broken insulator, oil fouling or incorrect electrode gap.
18. If any of these conditions exist, replace the defective plugs and restart the engine.
19. If engine still runs rough, stop the engine and remove spark plug cables.
20. Test cables with ohmmeter.
21. If cables show too much resistance, replace them.
22. Test coil to distributor secondary cable with ohmmeter.
23. Replace spark cables in sets.
24. Remove distributor cap and inspect contacts inside cable tower.
25. Inspect inside of distributor cap for corrosion on contacts.
26. Look for small cracks or carbon tracks.
27. Inspect carbon button in distributor cap.
28. Remove coil wire from center of distributor cap and hold approximately 1/2" from engine metal parts.
29. Turn on ignition switch and operate starter with remote starter switch.
30. If spark jumps from wire to metal, coil, points and condenser are alright.

DEPT	PRG	DUTY	TASK	EN. OBJ.
IN	9043	C	05	2

INSTRUCTION SHEET

RVTC

PAGE 4 OF 4

31. If spark does not form, check for loose wires at coil primary leads.
32. Check points for hose leads or screws.
33. Check points for burned or pitted contacts.
34. Replace condenser if points are pitted.
35. If points are burned, check charging system for voltage above specification.
36. Test condenser or replace with a new one and start engine.
37. Remove coil and test it or replace with a new coil.
38. Start engine and let idle until warm, then grasp throttle and open it wide.
39. Check ignition timing and set to specification.

DEPT.	PRG	DUTY	TASK	EN. OBJ.
IN	9043	C	05	2

SELF-CHECK

RVTC

Directions

Evaluate your work by answering the items below.

All items should receive a "YES" response.

- | | <u>YES</u> | <u>NO</u> |
|--|------------|-----------|
| 1. Was the repair manual used for the make, model, and year of the vehicle?..... | _____ | _____ |
| 2. Were the battery and starter tested?..... | _____ | _____ |
| 3. Was the fuel system checked for possible leaks?.... | _____ | _____ |
| 4. Was the system checked for flooding?..... | _____ | _____ |
| 5. Were the spark plugs removed and inspected?..... | _____ | _____ |
| 6. Was the coil tested to see if it was firing?..... | _____ | _____ |
| 7. Was the primary circuit component tested?..... | _____ | _____ |
| 8. Were the contact points tested?..... | _____ | _____ |
| 9. Was the condenser tested?..... | _____ | _____ |
| 10. Was the secondary circuit and component tested?.... | _____ | _____ |
| 11. Was the coil terminal checked for corrosion?..... | _____ | _____ |
| 12. Were the ignition switch circuits checked for shorts and open circuits?..... | _____ | _____ |
| 13. Were all necessary repairs and adjustments made according to the repair manual?..... | _____ | _____ |

If you received a "NO" response for any item, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	05	2

PERFORMANCE TEST FOR TASK NO. C-05

RVTC

TASK:

Diagnose and Repair Ignition System Problems

IN-9043-C-05

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will diagnose and repair ignition system problems. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Was the correct repair manual used?.....		
2.	Were the battery and starter tested?.....		
3.	Was the fuel system checked for problems?.....		
4.	Was the system checked for flooding?.....		
5.	Were the spark plugs removed and checked?.....		
6.	Was the coil tested to see if it was firing?.....		
7.	Were the primary circuit components tested?.....		
8.	Were the contact points checked or tested?.....		
9.	Were the secondary circuit components tested?.....		
10.	Was the coil terminal checked for corrosion?.....		
11.	Were the switch circuits tested for shorts?.....		
12.	Was the repair manual used to make repairs and adjustments?.....		

☐ ATTAINED
☐ NOT ATTAINED

Score _____

DEPT.	PROG.	DUTY	TASK	ATTEMPT
IN	9043	C	05	

EVALUATOR'S SIGNATURE _____
 Page 1 of 1

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VO-TECH CENTER

7700 State Road 544 N
Winter Haven, Florida 33860

IN-9043-C-04

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Disassemble and Reassemble Ignition Components

DUTY:

Troubleshooting and Repairing Electrical System

PURPOSE :

Repair and maintenance of the ignition system is an important part of the automotive mechanic's job. The ignition system must operate properly for an engine to run efficiently. It is essential to repair and maintain the ignition system.

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DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	C	04	Duty A

REVISED

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

GIVEN: a workable engine or a test vehicle,

YOU WILL: disassemble and reassemble ignition components.

HOW WELL: You must successfully complete the Written Test.
Your performance will be assessed by your instructor using the Performance Test on page 24.

NOTE:

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Describe the procedure to disassemble, inspect and reassemble an ignition distributor.
2. Identify parts and procedure for removal and installation of spark plugs.
3. Disassemble, inspect and reassemble ignition components.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	04

ENABLING OBJECTIVE NO. 1

RVTC

Describe the procedure to disassemble, inspect and reassemble an ignition distributor.

LEARNING STEPS

1. View Resource No. 1 to identify the components of the ignition distributor.
2. View Resource No. 2 to identify ignition system components and their function.
3. View Resource No. 3 to identify the steps in testing a distributor.
4. Read Resource No. 4 to identify the steps in removing and installing a distributor.
5. Evaluate your knowledge by completing the Self-Check.
6. Go on to Enabling Objective No. 2.

RESOURCES

1. Instruction Sheet enclosed, Distributor
2. Hoffman slide/tape units:
6.1.6, 6.1.A and C.1.C.
3. Hoffman slide/tape units:
6.3.1, 6.3.2, 6.3.3, 6.3.A,
6.3.5, 6.3.6, 6.3.B, and 6.3.C.
4. Instruction Sheet enclosed, Distributor Removal and Installation
5. Self-Check enclosed.

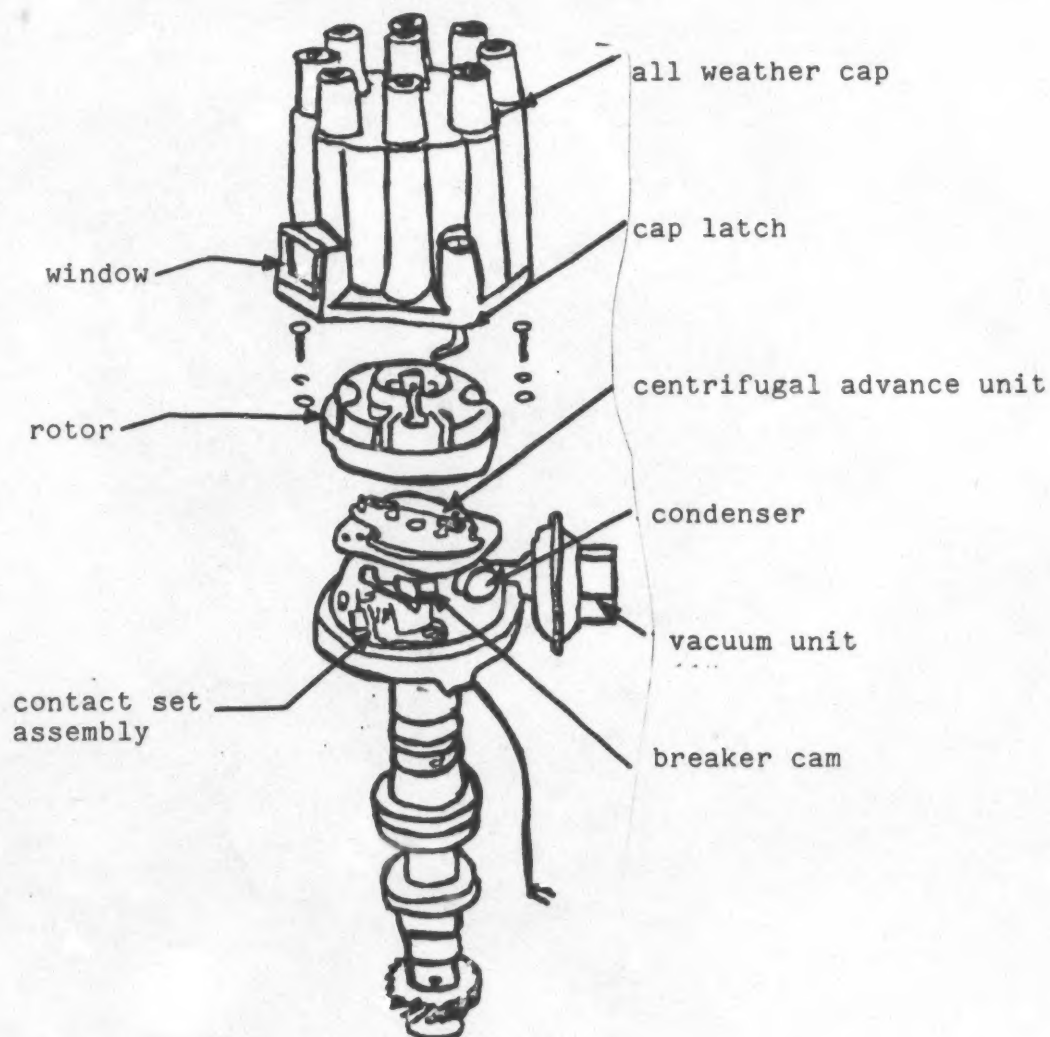
DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	04	1

INSTRUCTION SHEET

RVTC

PAGE 1 OF 1

Distributor



DEPT.	PROG	DUTY	TASK	EN OBJ.
IN	9043	C	04	1

INSTRUCTION SHEET

5
RVTC

PAGE 1 OF 2

Distributor Removal and Installation

1. Remove the air cleaner, if necessary. Disconnect the vacuum hose(s) at the distributor.
2. Disconnect the primary wire running from the coil to the distributor.
3. Unfasten the distributor-cap retainers, and remove the cap. Place the cap and wires to one side, out of the way.
4. Scratch aligning marks on the distributor housing and the cylinder block. The marks locate the position of the distributor housing.
5. Scribe another mark on the distributor housing beneath the tip of the rotor. This mark locates the position of the rotor in the distributor housing.
6. Remove the distributor hold-down bolt and clamp. Lift the distributor out of the block.

NOTE: IF THE ENGINE IS NOT CRANKED WHILE THE DISTRIBUTOR IS REMOVED, THE DISTRIBUTOR MAY BE INSTALLED IN THE CORRECT POSITION BY ALIGNING THE MARKS DURING THE REMOVAL.

If marks were made during distributor removal, or if the engine was cranked while the distributor was removed, the engine must be timed. This is necessary to establish the proper relationship between the distributor rotor and the No. 1 piston.

1. Remove the No. 1 spark plug from the cylinder head. Place a shop towel over your finger, and cover the spark plug hole.
2. Crank the engine until you feel compression pressure.
3. Bump the engine with the starting motor until the timing marks on the crankshaft pulley and the timing cover are aligned.

NOTE: WHEN THE TIMING MARKS ARE PROPERLY ALIGNED, THE NO. 1 CYLINDER IS IN THE FIRING POSITION.

DEPT	PROG	DUTY	TASK	EN OBJ.
IN	9043	C	04	1

INSTRUCTION SHEET

6
RVTC

PAGE 2 OF 2

4. Check that the distributor gasket or rubber O-ring seal is in place on the distributor housing. Position the distributor in the block with the rotor at No. 1 firing position.
5. Check that the distributor housing is sealed fully against the cylinder block. If the distributor housing is not seated fully against the cylinder block, the oil pump shaft is not engaged. To engage the oil pump shaft, press down firmly on the distributor housing with your hand. Bump the engine a few times with the starting motor, until the distributor housing drops into place.
6. Install, but do not tighten, the distributor housing retaining clamp and bolt. The bolt should be just loose enough to allow the distributor to be turned by hand.
7. Rotate the distributor until the breaker points begin to open to fire the No. 1 cylinder. Do this very carefully, or the engine will not start.
8. Place the distributor cap in position on the distributor. Check that the tip of the rotor lines up with the distributor cap terminal for the No. 1 spark plug.
9. Install the distributor cap and wires, if removed. Check that the spark plug wires are correctly installed in the distributor cap. You should free the spark plug wire.
10. Connect the primary wire from the coil to the distributor (Do not connect the vacuum hose).
11. Start the engine. Set the ignition timing using the timing light. Connect the vacuum hose at the distributor. Replace the air cleaner (if removed).

DEPT	PROG	DUTY	TASK	EN OBJ.
IN	9043	C	04	1

589

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. To statically set the timing, the circuit test light is connected to the ground and:
 - a. battery.
 - b. No. 1 plug wire.
 - c. distributor side of the coil.
 - d. battery side of the coil.
2. To advance the timing, the distributor must be turned:
 - a. clockwise.
 - b. counter clockwise.
 - c. opposite the rotor rotation.
 - d. the same direction as the rotor rotation.
3. The distributor cap must be checked for:
 - a. carbon tracks or cracks.
 - b. worn or chipped button.
 - c. dirt or oil.
 - d. all of the above.
4. To perform a point resistance test the key must be:
 - a. on and the points open.
 - b. on and the points closed.
 - c. off and the points open.
 - d. off and the points closed.
5. Adjust the point resistance by bending the:
 - a. pivot post.
 - b. breaker plate.
 - c. stationary point bracket.
 - d. moveable point arm.
6. The two most common plug sockets are:
 - a. 3/4 and 5/8.
 - b. 7/8 and 9/16.
 - c. 13/16 and 5/8.
 - d. 3/4 and 7/8.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	04	1

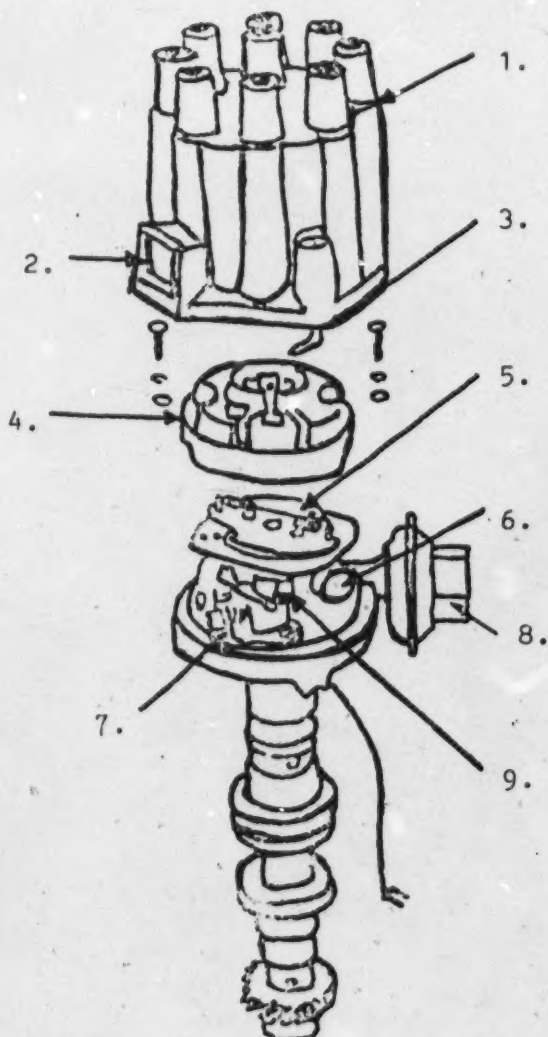
SELF-CHECK

RVTC

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. Dwell affects timing.
2. A faulty condenser causes points to burn.

Evaluate your knowledge by identifying the parts of the component below on a separate sheet of paper.



- a. contact set assembly
- b. breaker cam
- c. centrifugal advance unit
- d. all weather cap
- e. condenser
- f. vacuum unit
- g. cap latch
- h. window
- i. rotor
- j. primary lead

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	04	1

SELF-CHECK

RVTC

Answer KeyMultiple choice questions

1. c
2. c
3. d
4. b
5. d
6. c

True-False questions

1. T
2. T

Matching questions

1. d
2. h
3. g
4. i
5. c
6. e
7. a
8. f
9. b

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	04	1

ENABLING OBJECTIVE NO. 2
RVTC

Identify parts and procedure for removal and installation of spark plugs.

LEARNING STEPS

1. View Resource No. 1 to identify the different types of spark plugs.
2. View Resource No. 2 to identify the steps in inspecting the spark plugs.
3. View Resource No. 3 to identify the procedure for removal and installation of spark plugs.
4. Evaluate your knowledge by completing the Self-Check.
5. When you think you can attain this task, take the Written Test.

RESOURCES

1. Hoffman slide/tape units:
6.4.A, 6.4.2, and 6.4.B.
2. Hoffman slide/tape units:
6.4.C, 6.4.D and 6.4.6.
3. a. Instruction Sheet enclosed,
Spark Plug Removal and In-
stallation
b. Hoffman slide/tape unit:
6.4.E.
4. Self-Check enclosed.
5. Written Test for task C-04.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	04	2

INSTRUCTION SHEET

RVTC

PAGE 1 OF 2Spark Plug Removal and Installation

1. Look up spark plug gap in Motors.
2. Obtain from tool crib, fender covers, air blow gun, 3/8" dr. flex head ratchet, 13/16" or 5/8" spark plug socket, plug gapper and thread chaser, if needed.
3. Install fender covers on car.
4. With air blow gun, blow away any dirt and grease that may be around the plugs.
5. Remove plug wires -- twist as you pull by the boot.
6. As demonstrated in video, remove spark plugs, being sure to support the head of the ratchet. Lay the plug on fender cover in order of removal to determine which cylinder each plug came from for plug analysis.
7. Analyze each plug to determine if there is a problem with any of the cylinders. Refer to wall chart for help.
8. If plugs are going to be replaced, advance to Step 15. If cleaning, continue.
9. Obtain from tool crib a container and some lacquer thinner.
10. Widen gap on plugs.
11. Clean plugs as directed in video presentation.
12. Clean as much of the carbon deposits off as possible.
13. Clean plugs in lacquer thinner to remove ALL sand from inside and threads.
14. With air blow gun, blow the plugs dry and clean from thinner or sand. Be sure threads are clean.
15. Gap the plugs to factory specifications.
16. Have your instructor check the plugs.
17. If the plugs came out hard, run a spark plug thread chaser through each plug hole.

DEPT.	PROG	DUTY	TASK	EN OBJ.
IN	9043	C	04	2

INSTRUCTION SHEET

RVTC

PAGE 2 OF 2

18. Install the plugs by hand. Never start plug with a ratchet.
19. Torque the plugs as recommended in Champions Service Manual. Plugs without gaskets, 1/2 turn past finger tight. Plugs without gasket, 1/16" turn past finger tight.
20. Install plug wires, being certain they are on all the way and on the right plug.
21. Have instructor check plug and wire installation.
22. Install air cleaner and vacuum lines if removed.

DEPT.	PROG	DUTY	TASK	EN OBJ.
IN	9043	C	04	2

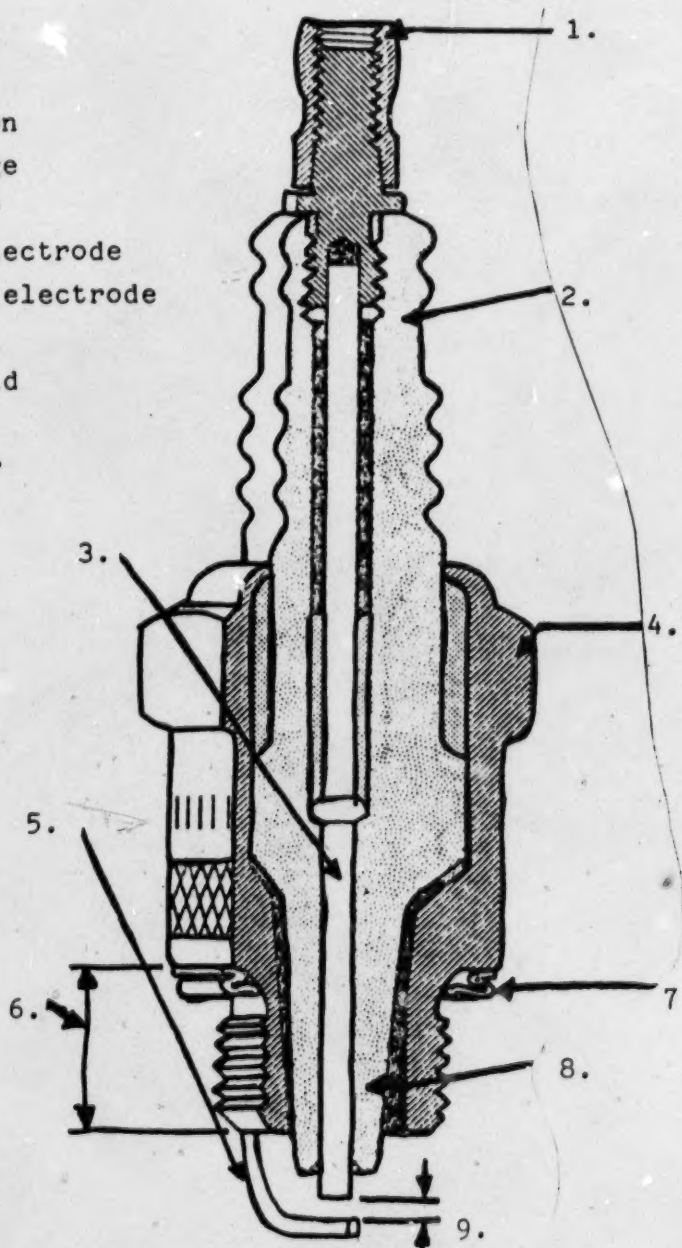
SELF-CHECK

RVTC

Directions

Evaluate your knowledge by identifying parts of the component below on a separate sheet of paper.

- a. stud
- b. cement
- c. decoration
- d. heat range
- e. insulator
- f. ground electrode
- g. positive electrode
- h. gasket
- i. hex-shield
- j. gap
- k. insulator
- l. reach



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	04	2

SELF-CHECK

RVTC

Answer Key

1. a
2. e
3. i
4. g
5. h
6. f
7. l
8. k
9. j

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	04	2

WRITTEN TEST FOR TASK NO. C-04

RVTC

TASK:

Disassemble and Reassemble Ignition Components

IN-9043-C-04

Directions

PAGE 1 OF 4

The purpose of this test is to determine if you fully understand how to disassemble, inspect and reassemble ignition system components. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Multiple Choice. On the separate Answer Sheet, put the letter of the correct answer in the blank to the left of the number of the question.

DO NOT MARK ON THIS TEST!

Multiple Choice questions

1. One of the functions of the ignition system is to:
 - a. compress air and fuel in the cylinders.
 - b. time the spark in the combustion chamber.
 - c. provide the charging circuit with a high voltage spark.
 - d. all of the above.
2. On some model engines, the distributor is driven directly by the:
 - a. crankshaft.
 - b. mainshaft.
 - c. camshaft.
 - d. none of the above.
3. Which part of the distributor is the cam assembly located?
 - a. on the upper part
 - b. in the middle
 - c. on the lower part
 - d. none of the above
4. The cam assembly is constructed with lobes, one for:
 - a. each cylinder.
 - b. every other cylinder.
 - c. each valve of the engine.
 - d. every other valve of the engine.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	04

WRITTEN TEST FOR TASK NO. C-04

RVTC

TASK:

Disassemble and Reassemble Ignition Components

IN-9043-C-04

PAGE 2 OF 4

5. What part of the ignition system controls the windings of ignition coil?
 - a. the spark plugs
 - b. the condenser
 - c. the breaker points
 - d. all of the above
6. The number of degrees the points remain closed is called:
 - a. ignition timing.
 - b. cam angle.
 - c. point gap.
 - d. none of the above.
7. During what stroke does pre-ignition occur?
 - a. during the intake stroke
 - b. during the compression stroke
 - c. during the power stroke
 - d. during the exhaust stroke
8. Pre-ignition causes:
 - a. the mixture of air and fuel to burn ahead of schedule.
 - b. the mixture of air and fuel to burn late in the power stroke.
 - c. an increase in engine power.
 - d. none of the above.
9. Late ignition happens when the spark at the combustion chamber occurs:
 - a. before the piston reaches top dead center.
 - b. when the piston is on the top dead center.
 - c. after the piston leaves the top dead center position.
 - d. none of the above.
10. In operation, as engine speed increases, the spark should be sent to the cylinder:
 - a. before the piston reaches the top dead center position.
 - b. as the piston reaches the top dead center position.
 - c. after the piston leaves the top dead center position.
 - d. all of the above.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	04

WRITTEN TEST FOR TASK NO. C-04

RVTC

TASK:

Disassemble and Reassemble Ignition Components

PAGE 3 OF 4

11. Which of the following is a type of automatic timing device, used with ignition distributors?
 - a. the centrifugal advance
 - b. the fuel vacuum advance
 - c. the combination, centrifugal and vacuum advance
 - d. all of the above
12. How are the advance weights of a distributor advance mechanism held in the retarded position?
 - a. by engine vacuum
 - b. by return springs
 - c. by engine compression
 - d. all of the above
13. What happens when the upper cam assembly opens the points ahead of time?
 - a. it advances the spark to the cylinder
 - b. it retards the spark to the cylinder
 - c. it causes the gases to burn late in the engine cycle
 - d. none of the above
14. When advance weights begin losing their centrifugal force, the ignition timing will:
 - a. be retarding.
 - b. be advancing.
 - c. remain the same.
 - d. none of the above.
15. During the idle speeds (600-800 R.P.M.) what is the speed relationship between the main shaft of the distributor and the upper cam assembly?
 - a. the upper cam assembly is turning faster than the distributor main shaft
 - b. the main shaft of the distributor is revolving faster than the upper cam assembly
 - c. they are both turning at the same speeds
 - d. neither shaft is turning at idle speeds

DEPT.	PROG.	DUTY	TASK
IN	9043	C	04

WRITTEN TEST FOR TASK NO. C-04

RVTC

TASK:

Disassemble and Reassemble Ignition Components

PAGE 4 OF 4

16. On some engines, the distributor vacuum advance is activated:
- by engine compression.
 - by engine vacuum.
 - by the ignition coil.
 - all of the above.
17. On some model distributors, a linkage from the vacuum chamber rotates a unit called:
- a breaker plate.
 - an upper cam assembly.
 - a rotor.
 - none of the above.
18. How is the vacuum advance activated on some vehicles equipped with emission controls?
- by vehicle speed
 - engine vacuum controlled by vehicle speed
 - by compression pressure
 - all of the above
19. Initial ignition timing must be set during idle speeds with the use of a:
- dwel meter.
 - compression gauge.
 - voltmeter.
 - none of the above.
20. Which of the following is performed by the ignition system?
- a high voltage spark
 - to deliver a spark to the engine at the right instant
 - to deliver a spark to the engine during all engine speeds
 - all of the above

DEPT.	PROG.	DUTY	TASK
IN	9043	C	04

ENABLING OBJECTIVE NO. 3

RVTC

Disassemble, inspect and reassemble ignition components.

LEARNING STEPS

1. Review Resource No. 1 which identifies the procedure for disassembly, inspection and reassembly of ignition system components.
2. Practice disassembling and reassembling ignition system components using Resource No. 2.
3. When you think you can perform this task, take the Performance Test.

RESOURCES

1.
 - a. Instruction Sheet enclosed Distributor
 - b. Instruction Sheet enclosed Point Removal and Installation
 - c. Instruction Sheet enclosed Spark Plug Removal and Installation
2. Test vehicle
3. Performance Test for task C-04.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	04	3

INSTRUCTION SHEET

RVTC

PAGE 1 OF 2Point Removal and Installation

1. Look up in Motors Manual, the dwell and timing specs for engine. Use specs on engine decal if different from Motors.
2. Obtain from tool crib, tune-up kit, medium screwdriver, fender covers, timing light dwell-tack, distributor wrench and shop towel.
3. Remove air cleaner and plug vacuum leak.
4. Remove distributor cap and check for carbon tracking, worn button, dirt or contaminants and cracks.
5. Remove rotor and check.
6. Perform point resistant test before removing points. KEY ON POINTS CLOSED.
7. Remove points and condenser, use screw starter to prevent losing screws down distributor.
8. Examine point condition and rubbing block.
9. Clean breaker plate and cam with solvent. Remove all grease, oil, dirt and varnish.
10. Clean and align new points.
11. Apply a light coat of cam lub on cam and rubbing block of points.
12. Connect condenser and primary lead on points, back to back and tight.
13. Install points and condenser onto breaker plate. Leave point screw semi-loose if not a Delco V-8 distributor.
14. If Delco V-8 distributor, advance to Step 21.
15. If Ford, Chrysler or G. M. 6 cylinder, then connect dwell tack and adjust points while cranking the engine. DO NOT crank engine for more than 15 seconds.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	04	3

INSTRUCTION SHEET

RVTC

PAGE 2 OF 2Ground Coil Wire

16. Tighten point screws and re-check dwell.
17. If dwell has not changed, install rotor and cap. Be sure rotor is down all the way and cap is on right.
18. Re-connect coil wire.
19. Start engine and check dwell running with vacuum advance disconnected.
20. If dwell changes, go back and re-adjust the dwell. Then advance to Step 24.
21. On Delco distributors for V-8, clean and lightly lub centrifugal advance unit. DO NOT HAVE ANY EXCESS GREASE.
22. Install rotor and cap. Be sure that each are indexed properly.
23. Start engine, lift window on cap and adjust dwell from low side up, engine idling.
24. Shut engine off and connect timing light.
25. Clean and chalk timing marks.
26. Be sure timing light leads are away from fan, alternator blower, and exhaust manifold, then start engine.
27. Disconnect and plug vacuum line on distributor.
28. Adjust timing to specification, engine at idle.
29. Tighten distributor, hold down and re-check timing.
30. Connect vacuum line to distributor.
31. Shut engine off and disconnect timing light and dwell meter.
32. Install air cleaner and vacuum line.

DEPT.	PROG	DUTY	TASK	EN. OBJ.
IN	9043	C	04	3

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by answering True or False to the items below on a separate sheet of paper.

1. It is normal for used points to have a dull, slate gray color.
2. Points should be cleaned with an emery cloth.
3. Point gap affects dwell.
4. Dwell affects timing.
5. When the spark plugs have been removed they should be kept in order of removal for a plug analysis.

Evaluate your knowledge by putting the letter of the correct answer on a separate sheet of paper.

1. To perform a point resistance test the ignition key must be:
 - a. on and the points off.
 - b. on and the points closed.
 - c. off and the points open.
 - d. off and the points closed.
2. Cam angle or dwell is the:
 - a. number of degrees the cam turns while the points are open.
 - b. angle at which the rubbing block contacts the cam.
 - c. distance between the lobes on the cam.
 - d. number of degrees the cam turns while the points are closed.
3. The two most common plug socket sizes are:
 - a. 3/4 and 5/8.
 - b. 7/8 and 9/16.
 - c. 13/16 and 5/8.
 - d. 3/4 and 7/8.
4. The remote starter switch is connected to the:
 - a. positive battery cable and s terminal on the solenoid.
 - b. starter cable and ground.
 - c. ignition switch and s terminal on the solenoid.
 - d. remote starter.

Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	04	3

SELF-CHECK**RVTC**Answer KeyTrue-False questions

1. F
2. F
3. T
4. T
5. T

Multiple Choice questions

1. b
2. d
3. c
4. a

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	04	3

PERFORMANCE TEST FOR TASK NO. C-04

RVTC

TASK:

Disassemble and Reassemble Ignition Components

IN-9043-C-04

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will disassemble, inspect and reassemble ignition components. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Was the repair manual used to complete repairs?.....		
2.	Were the ignition components visually inspected?.....		
3.	Were spark plugs removed and serviced according to the <u>Spark Plug Removal and Installation Instruction Sheet</u> ?.....		
4.	Was the distributor removed according to the <u>Distributor Removal and Installation Instruction Sheet</u> ?.....		
5.	Was the breaker plate cleaned?.....		
6.	Were distributor wires connected to the proper terminals?.....		
7.	Were all vacuum lines connected?.....		
8.	Was the dwell set to specifications?.....		
9.	Was the timing set after the dwell?.....		
10.	Were the plug wires installed according to the firing order?.....		

☐ ATTAINED
☐ NOT ATTAINED

Score _____

DEPT.	PROG.	DUTY	TASK	ATTEMPT
IN	9043	C	04	

EVALUATOR'S SIGNATURE _____
 Page 1 of 1

DRAFT
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RIDGE

VO-TECH CENTER

7700 State Road 544 N
Winter Haven, Florida 33880

IN-9043-C-03

AUTOMOTIVE MECHANICS

A STUDENT LEARNING GUIDE

TASK:

Identify Ignition Components and Describe Operation

DUTY:

Troubleshooting and Repairing Electrical System

PURPOSE :

Since ignition system service is one of the most common operations for almost any mechanic, it is necessary that you understand fully the function of each component and where it fits into the total system's operation. A great deal of troubleshooting depends on knowing how the system functions.

DEPT.	PROG.	DUTY	TASK	PRE REQ.
IN	9043	C	03	

REVISED :				
12/80				

STUDENT PERFORMANCE OBJECTIVES:**RVTC****TERMINAL PERFORMANCE OBJECTIVE:**

- GIVEN:** an ignition system,
- YOU WILL:** identify the ignition components and describe their operation.
- HOW WELL:** You must successfully complete the Written Test.
Your performance will be assessed by your instructor using the Performance Test on page 20.

NOTE:

IF YOU THINK YOU CAN ALREADY PERFORM THIS TASK TO THE LEVEL INDICATED IN THE TERMINAL PERFORMANCE OBJECTIVE ABOVE, SEE YOUR INSTRUCTOR.

ENABLING OBJECTIVES:

1. Identify ignition system components (conventional ignition).
2. Identify ignition system components in electronic ignition.
3. Trace the circuits of an ignition system (conventional ignition).
4. Trace the circuits of an ignition system (electronic ignition).
5. Describe the operation of the ignition system.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	03

ENABLING OBJECTIVE NO. 1
RVTC

Identify ignition system components (conventional ignition).

LEARNING STEPS

1. Read Resource No. 1a and complete Resource No. 1b to identify ignition system components.
2. Using Resource No. 2, practice identifying ignition system components.
3. Go on to Enabling Objective No. 2.

RESOURCES

1. a. Text: Crouse Automotive Mechanics, pages 297-305.
b. Self-Check enclosed.
2. Ignition system Display No. 1--V-8.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	03	1

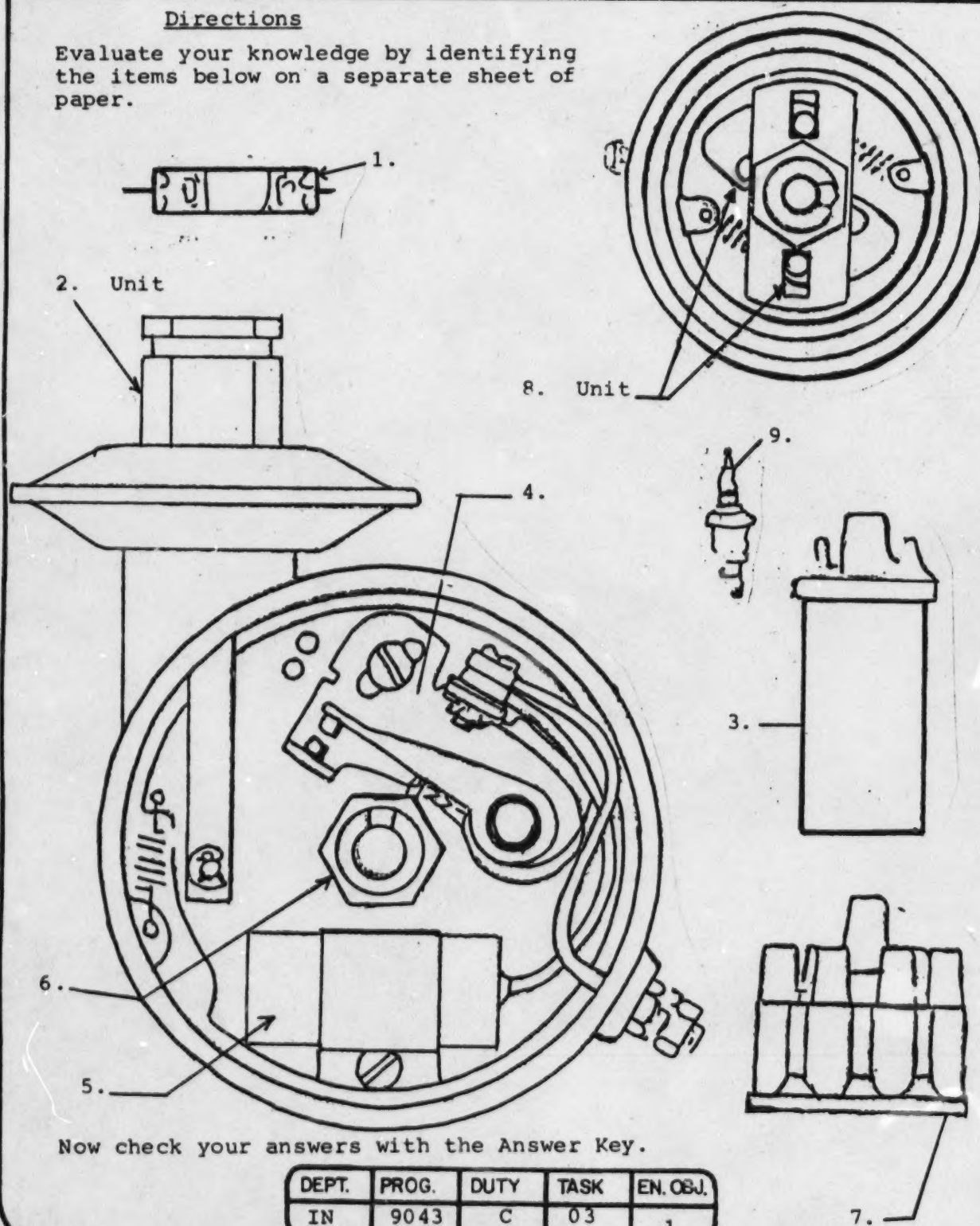
610

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by identifying the items below on a separate sheet of paper.



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	03	1

SELF-CHECK

RVTC

Answer Key

1. Resistor
2. Vacuum Advance Unit
3. Coil
4. Points
5. Condenser
6. Shaft
7. Distributor cap
8. Centrifugal Advance unit
9. Spark plug

All of your answers should agree with the answers in the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	03	1

ENABLING OBJECTIVE NO. 2

RVTC

Identify ignition system components in electronic ignition.

LEARNING STEPS

1. View Resource No. 1 which explains the components of electronic ignition.
2. Read Resource No. 2 describing the components of electronic ignition.
3. Evaluate your knowledge by completing the Self-Check.
4. Go on to Enabling Objective No. 3.

RESOURCES

1. Bergwall Filmstrip/tape: No. 426.
2. Text: Crouse Automotive Mechanics, pages 306-315.
3. Self-Check enclosed.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	3	2

SELF-CHECK

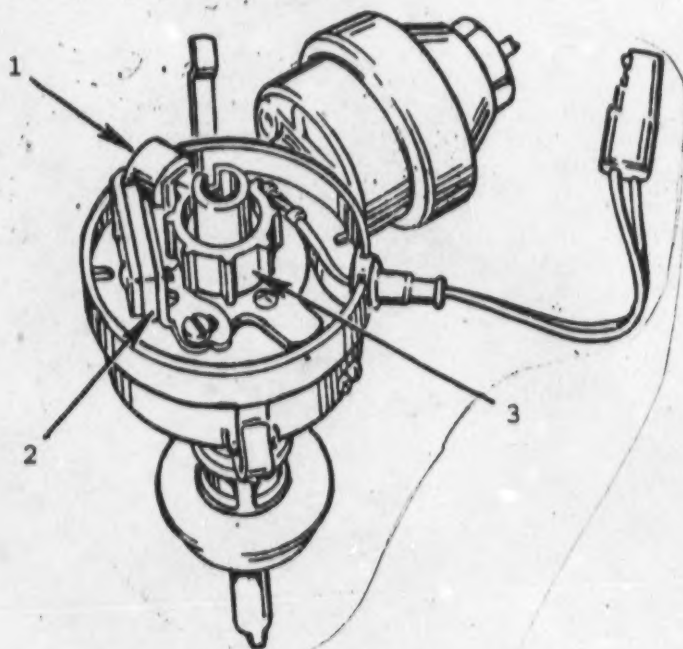
RVTC

Directions

Evaluate your knowledge by matching the items below and on the following pages. Use a separate sheet of paper.

Diagram I:

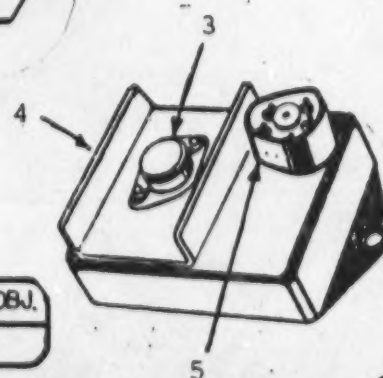
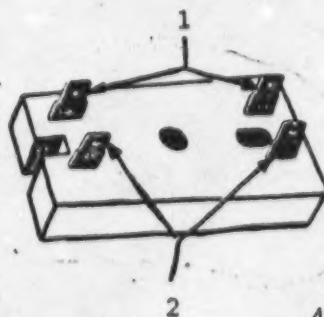
- a. reluctor
- b. spring
- c. pick-up coil
- d. shell
- e. permanent magnet



Distributor Components

Diagram II:

- a. permanent magnet
- b. heat sink
- c. vacuum unit
- d. switching transistor
- e. harness plug
- f. rotor
- g. normal ballast resistor
- h. auxiliary ballast resistor



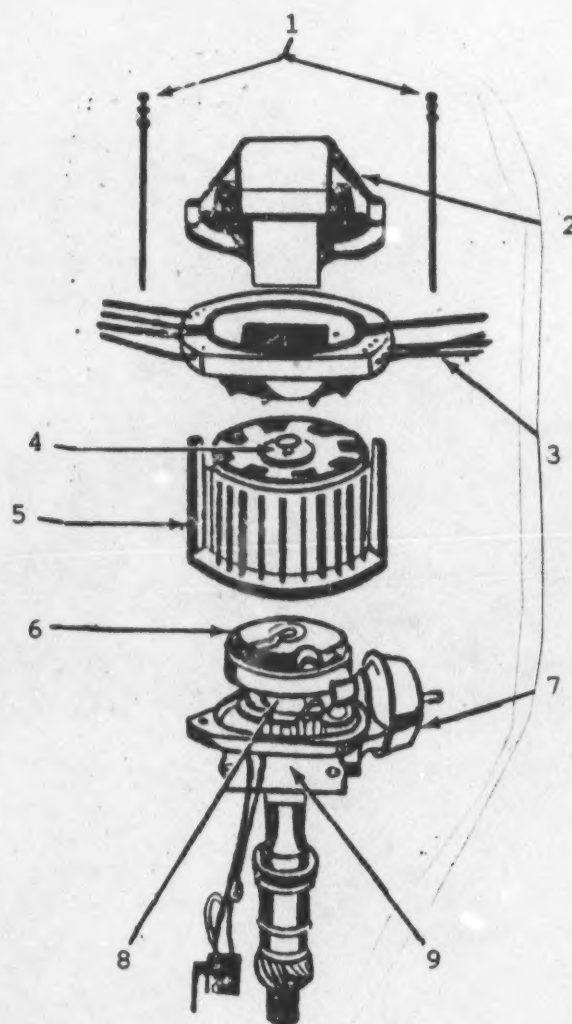
DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	03	2

SELF-CHECK

RVTC

Diagram III:

- a. washer
- b. electronic module
- c. coil
- d. spring
- e. rotor
- f. bolts
- g. vacuum unit
- h. shell
- i. pick-up coil and timer core
- j. cap and harness assembly



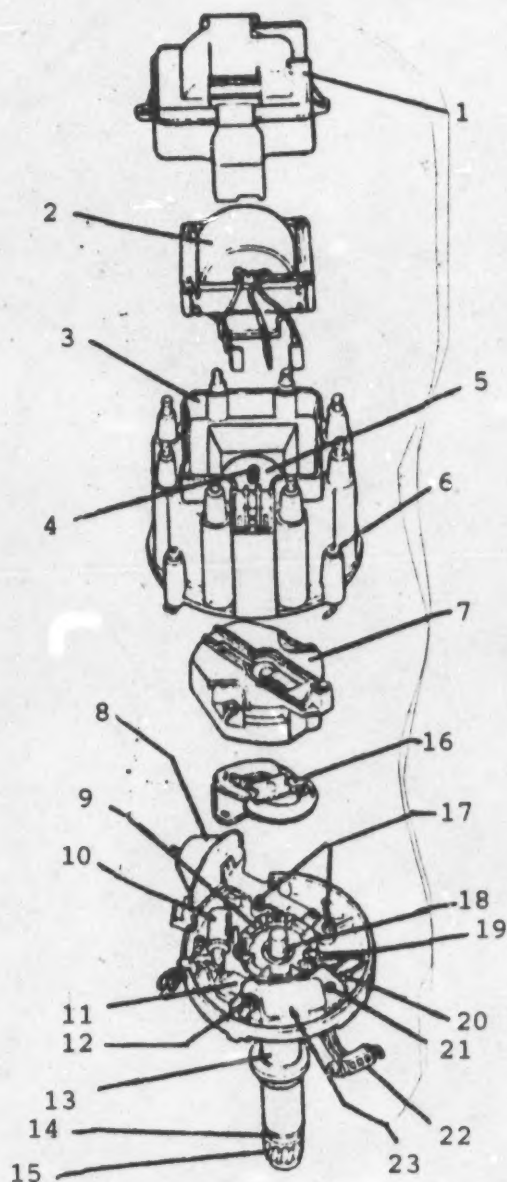
DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	03	2

SELF-CHECK

RVTC

Diagram IV:

- a. pok piece
- b. base plate
- c. module connection
- d. latches
- e. ignition coil
- f. seal
- g. armature
- h. coil cover
- i. rotor
- j. module
- k. capacitor
- l. gear
- m. ground screw
- n. vacuum unit advancing screw
- o. distributor cap
- p. centrifugal advance unit
- q. spring
- r. thin "C" washer
- s. vacuum control unit
- t. battery
- u. washer
- v. shaft
- w. pick-up coil
- x. connector
- y. pick-up coil leads
- z. housing
- aa. attaching screw



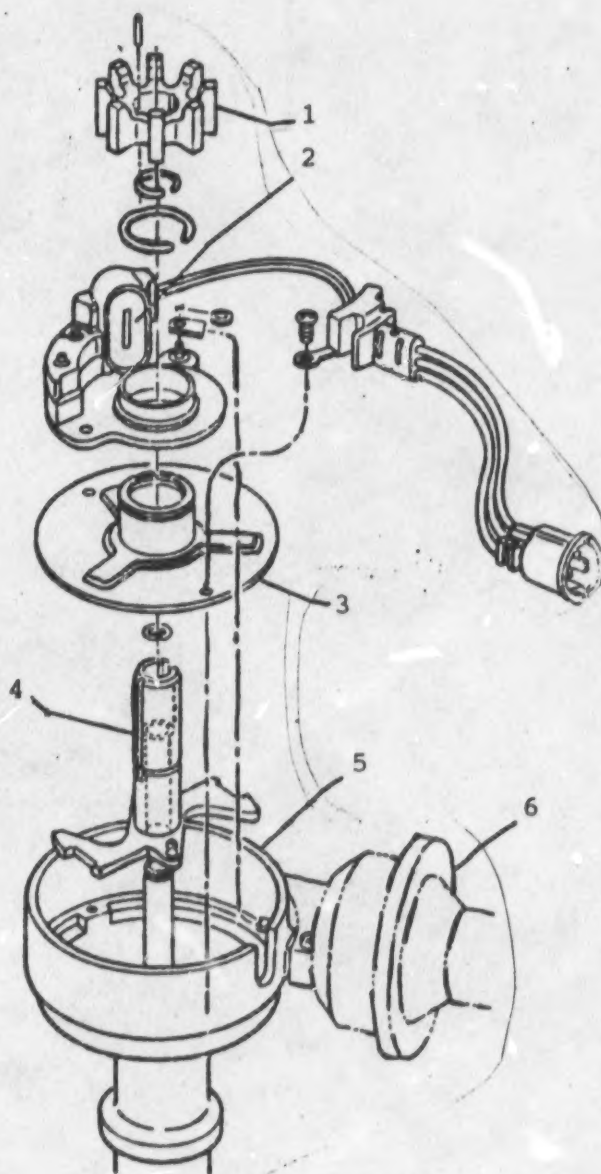
DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	03	2

SELF-CHECK

RVTC

Diagram V:

- a. battery
- b. shaft
- c. vacuum advance
- d. base plate
- e. magnetic pick-up assembly
- f. armature
- g. housing



DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	03	2

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by identifying the items below on a separate sheet of paper.

Diagram VI:

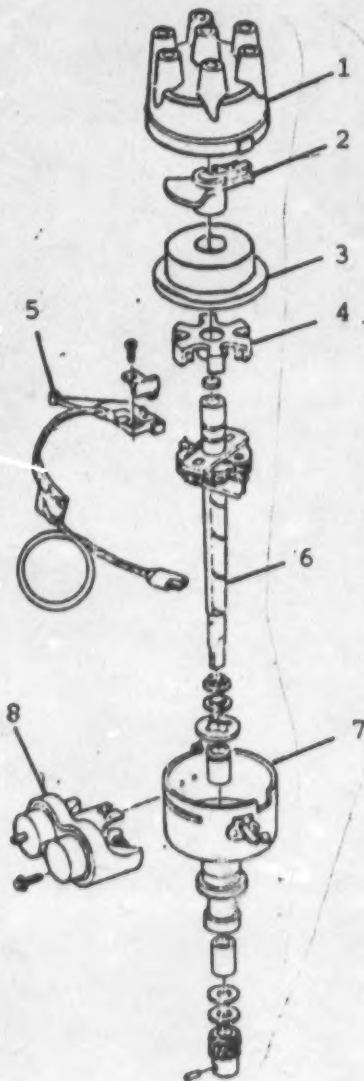
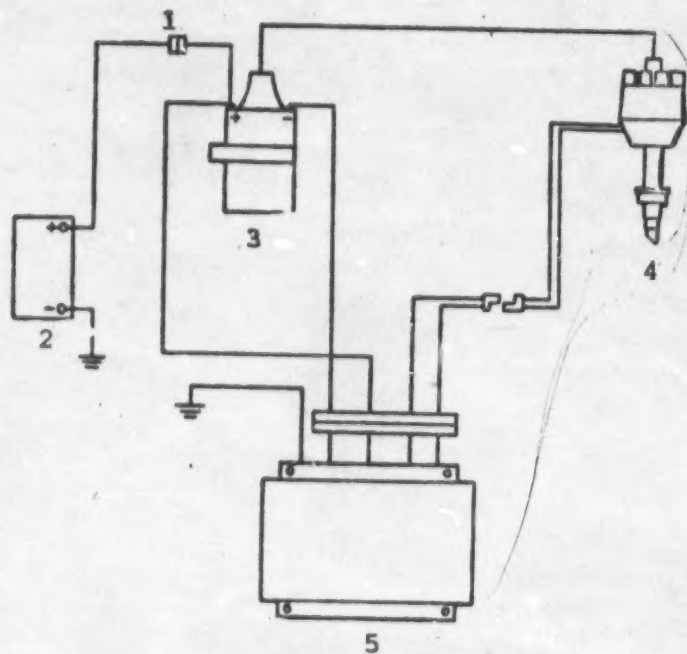


Diagram VII:



Now check your answers with the Answer Key.

DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	03	2

SELF-CHECK

RVTC

Answer Key

Diagram I:

1. c
2. e
3. a

Diagram II:

1. h
2. g
3. d
4. b
5. e

Diagram III:

1. f
2. c
3. j
4. d
5. h
6. e
7. g
8. i
9. b

Diagram IV:

1. h
2. e
3. o
4. q
5. f
6. d
7. i
8. s
9. a
10. k
11. c
12. m
13. z
14. u
15. l
16. p
17. n
18. r
19. w
20. y
21. aa
22. x
23. j

Diagram V:

1. f
2. e
3. d
4. b
5. g
6. c

Diagram VI:

1. distributor cap
2. rotor
3. dust shield
4. trigger wheel
5. sensor assembly
6. shaft
7. housing
8. vacuum control

Diagram VII:

1. ignition switch
2. battery
3. ignition coil
4. distributor
5. electronic control module

All of your answers should agree with the answers on the Answer Key. If you missed any, go back and repeat one or more of the Learning Steps for this Enabling Objective.

DEPT.	PROG.	DUTY	EN. OBJ.
IN	9043	C	2

ENABLING OBJECTIVE NO. 3

RVTC

Trace the circuits of an ignition system (conventional ignition).

LEARNING STEPS

1. Read Resource No. 1 to trace the circuits of an ignition system.
2. Evaluate your knowledge by completing the Self-Check.
3. Practice tracing the circuit of an ignition system using Resource No. 3.
4. Go on to Enabling Objective No. 4.

RESOURCES

1. Text: Crouse Automotive Mechanics, pages 296-305.
2. Self-Check enclosed.
3. Ignition system simulator display.

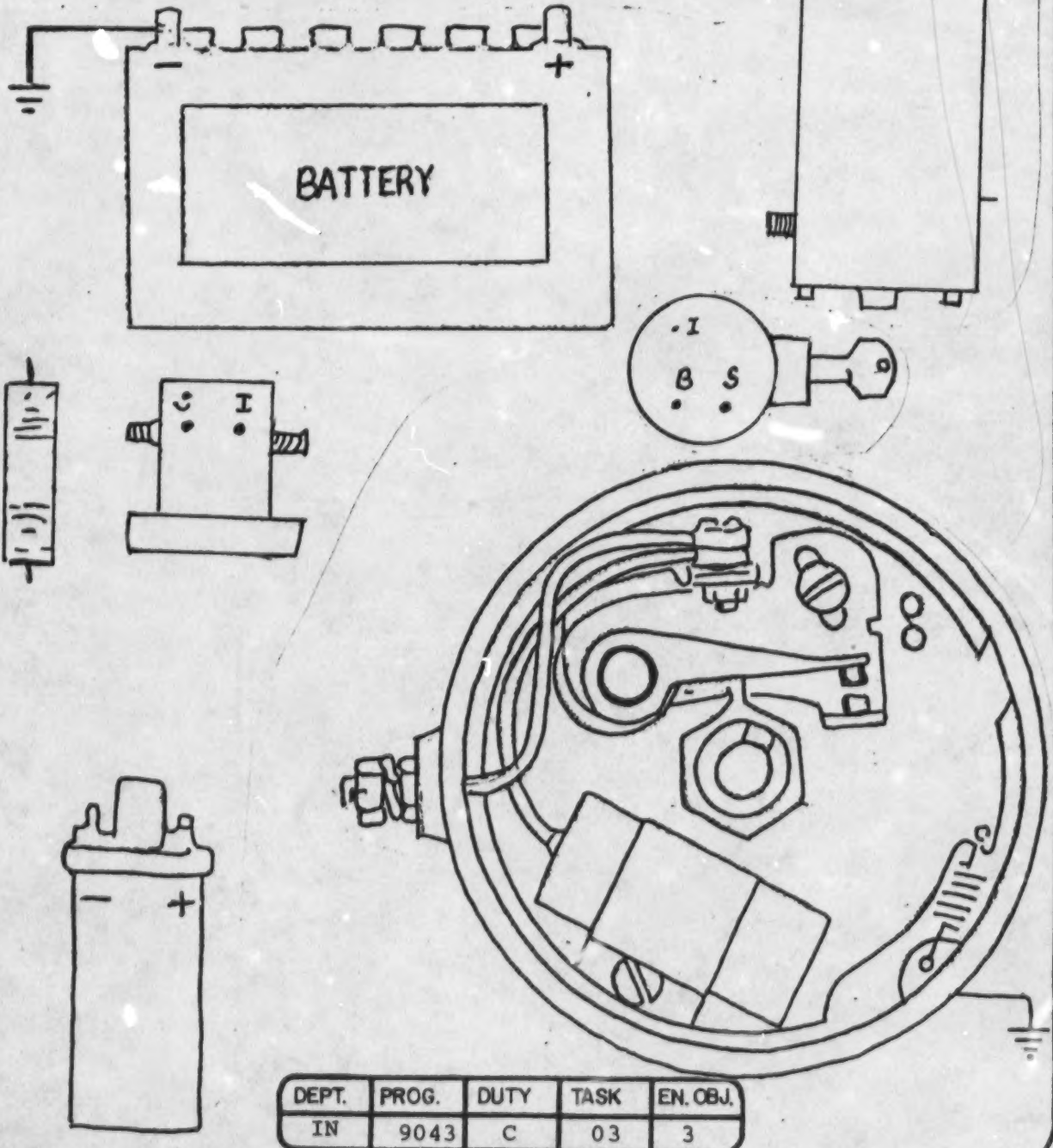
DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	03	3

SELF-CHECK

RVTC

Directions

Evaluate your knowledge by connecting each of the components by drawing a line to the terminals as they would be wired to an automobile. Use a separate sheet of paper. Have your instructor check your work.

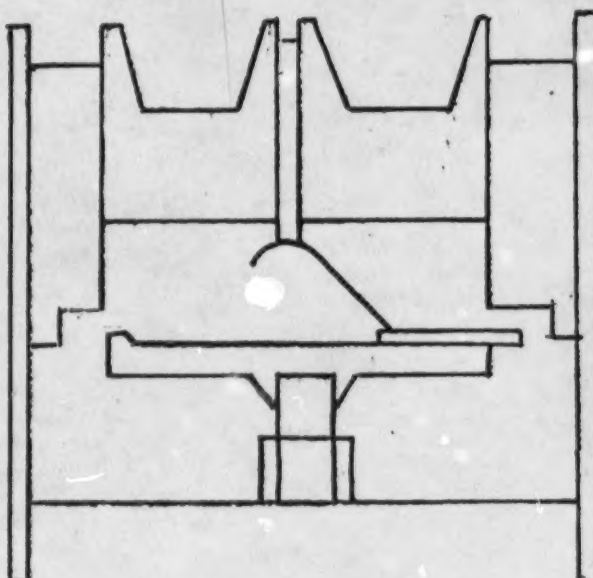
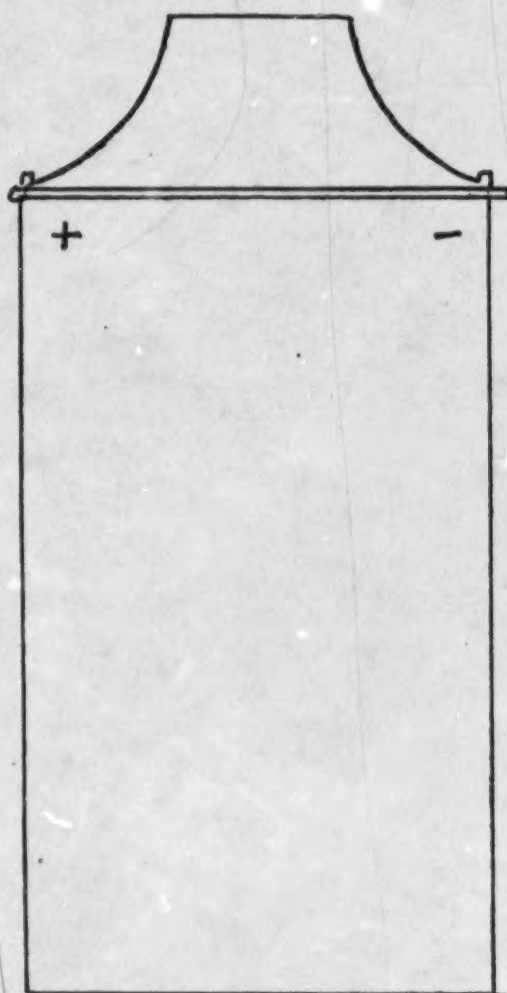


SELF-CHECK

RVTC

Directions

Evaluate your knowledge by tracing the secondary circuit from its source to the spark plug. Be sure to show where the current flows through the cap and rotor. Use a separate sheet of paper. Have your instructor check your work.



DEPT.	PROG.	DUTY	TASK	EN. OBJ.
IN	9043	C	03	3

ENABLING OBJECTIVE NO. 4
RVTC

Trace the circuits of an ignition system (electronic ignition).

LEARNING STEPS

1. Read Resource No. 1 describing the circuit of electronic ignition on Ford, GM and Chrysler vehicles.
2. Complete Resource No. 2 as a Self-Check.
3. Practice tracing the circuit of an electronic ignition system using Resource No. 3.
4. Go on to Enabling Objective No. 5.

RESOURCES

1. a. Text: Crouse 8th Edition, pages 306-315.
b. Bergwall Filmstrip/tape: No. 426.
2. Text: Crouse 8th Edition, page 315 - Review Questions 1-24.
3. Component vehicle with electronic ignition, designated by your instructor.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	03	4

ENABLING OBJECTIVE NO. 5
RVTC

Describe the operation of an ignition system.

LEARNING STEPS

1. View Resource No. 1 describing the operation of the ignition system.
2. Using Resource No. 2, practice describing the operation of the ignition system.
3. When you think you can attain this task, take the Written Test.
4. When you successfully complete the Written Test, take the Performance Test.

RESOURCES

1. Bergwall Filmstrip/tape: No. 401 and 426.
2.
 - a. Test vehicle with H.E.I.
 - b. Test vehicle with B.I.D.
 - c. Test vehicle with Chrysler Electronic ignition system
 - d. Conventional ignition system display
3. Written Test for task C-03.
4. Performance Test for task C-03.

DEPT.	PROG.	DUTY	TASK	EN.OBJ.
IN	9043	C	03	5

WRITTEN TEST FOR TASK NO. C-03

RVTC

TASK:

Identify Ignition Components and Describe Operation

IN-9043-C-03

DirectionsPAGE 1 OF 2

The purpose of this test is to determine if you fully understand how to identify ignition components and describe operation. To successfully complete this test, all items must be answered correctly. For those items missed, see your instructor for a review, additional learning activities or retesting.

The items below are Multiple Choice. On a separate Answer Sheet, put the letter of the correct answer in the blank to the left of the number of the question.

DO NOT MARK ON THIS TEST!

Multiple Choice questions

1. In the distributor, the cam has:
 - a. the same number of lobes as the engine has cylinders.
 - b. half as many lobes as engine cylinders.
 - c. twice as many lobes as engine cylinders.
 - d. no lobes at all on conventional ignition systems.
2. Electronic spark timing (MISAR) is used on:
 - a. Chrysler ignition.
 - b. GM ignition.
 - c. Ford ignition.
 - d. all three types of ignition systems.
3. Centrifugal advance affects the engine by:
 - a. increasing the spark voltage when the rpm's are increased.
 - b. increasing the timing of the spark when vacuum is applied.
 - c. advancing the timing as rpm's are increased.
 - d. increasing timing to the advance by moving the distributor plate.
4. The vacuum advance mechanism advances the spark according to changes in:
 - a. engine rpm.
 - b. vehicle road speed.
 - c. Venturi vacuum.
 - d. intake manifold vacuum.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	03

WRITTEN TEST FOR TASK NO. C-03

RVTC

TASK:

Identify Ignition Components and Describe Operation

PAGE 2 OF 2

5. Although the rotor blade in the distributor is rotating, it is always connected to the:
 - a. pick-up coil.
 - b. coil secondary circuit.
 - c. coil primary circuit.
 - d. secondary plug wires.
6. Dwell is:
 - a. the number of degrees of distributor cam rotation while the points are closed.
 - b. the number of degrees of distributor cam rotation while the points are open.
 - c. the number of degrees of crankshaft rotation while the points are closed.
 - d. the length of time the points are closed.
7. If the point gap is too narrow:
 - a. the dwell will not be affected.
 - b. the dwell will be too high.
 - c. the dwell will be too low.
 - d. the timing will be retarded.
8. Electricity will flow through the by-pass wire and deliver 12 volts to the coil when:
 - a. the points are closed.
 - b. the ignition is turned on.
 - c. the engine is cranking.
 - d. the points are open only.
9. A condenser which is weak can cause:
 - a. low voltage from coil secondary.
 - b. points to burn due to arcing.
 - c. hard starting.
 - d. all of the above.
10. You are going to test a vehicle with N.E.I. that will not start, the first step in testing it is to:
 - a. check for secondary voltage at the plug wire.
 - b. check for secondary voltage at the coil.
 - c. check the compression.
 - d. get the service manual for the vehicle.

DEPT.	PROG.	DUTY	TASK
IN	9043	C	03

PERFORMANCE TEST FOR TASK NO. C-03

RVTC

TASK:

Identify Ignition System Components and Describe Operation

IN-9043-C-03

STUDENT'S NAME _____

DATE _____

DIRECTIONS TO STUDENT: You will identify ignition system components and describe operation. You will be evaluated for attainment of this task, based upon the items listed below.

ITEM NO.	ITEMS TO BE EVALUATED For successful attainment <u>ALL</u> items must receive a "YES" response	YES	NO
1.	Was the coil identified?		
2.	Was the ballast resistor identified?		
3.	Was the distributor identified?		
4.	Was the rotor identified?		
5.	Was the condenser identified?		
6.	Was the vacuum advance identified?		
7.	Was the centrifugal advance identified?		
8.	Was the point cam identified?		
	<u>Electronic Ignition Parts and Circuits</u>		
9.	Was the dust shield identified?		
10.	Was the coil identified?		
11.	Was the control module identified?		
12.	Was the pick-up coil identified?		
13.	Was the electronic control unit identified (Chrysler units)?		
14.	Was the reluctor identified?		
15.	Was the tack lead identified?		
☐ ATTAINED ☐ NOT ATTAINED			
Score _____		EVALUATOR'S SIGNATURE _____	
DEPT.	PROG.	DUTY	TASK
IN	9043	C	03
		Page <u>1</u> of <u>1</u>	